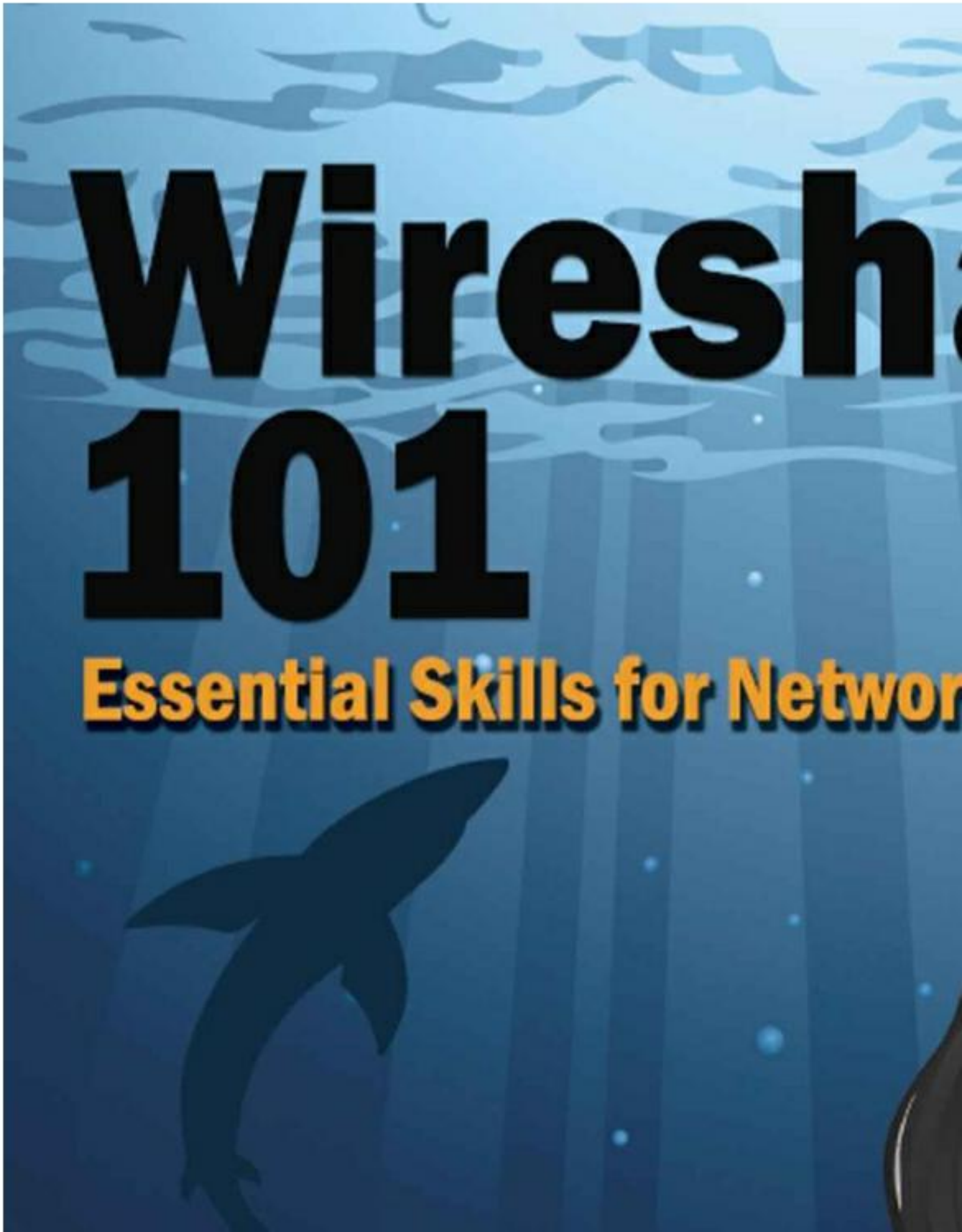
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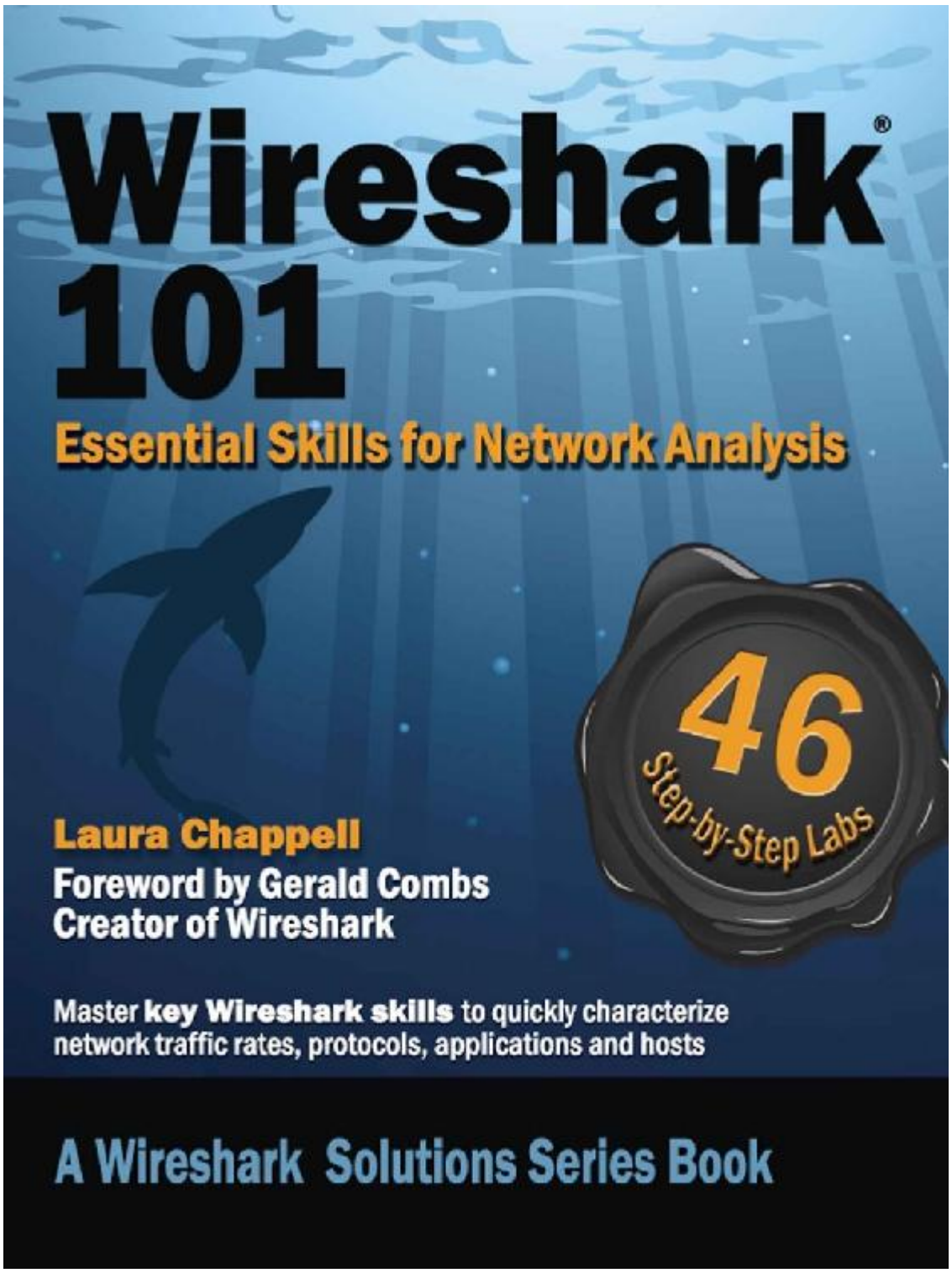
Wireshark®
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Step-by-Step Labs
Laura Chappell
Foreword by Gerald Combs
Creator of Wireshark
Master key Wireshark skills to quickly characterize
network traffic rates, protocols, applications and hosts
A Wireshark Solutions Series Book

Wireshark® 101

Essential Skills for Network Analysis

1st Edition

Always ensure you have proper authorization before you listen to and capture network traffic.

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Jim, you are my "style guru!" <grin>

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their Wireshark journey or honing their skills with this book.

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Instructor

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As always, my sincere thanks to the **Wireshark Core Developers** who have built Wireshark into an

indispensable tool. The current list of core developers can be found at *wiki.wireshark.org/Developers.*

If I've missed anyone in this acknowledgments section, I apologize sincerely.

Dedication

This book is dedicated to Ginny and Scott. Thanks for keeping me laughing!

Oh... and special thanks to my Mom (who just asked "Am I in the new book?"). Here you are, Mom.

Jeez... subtle <grin>.

Now that I've mentioned my Mom, I'd better keep the peace in the family by thanking my Dad (likely

the topic of another book someday).

About this Book

Who is this Book For?

This book is written for beginner analysts. This book provides an ideal starting point whether you are

interested in analyzing traffic to learn how an application works, you need to troubleshoot slow

network performance, or determine whether a machine is infected with malware.

Learning to capture and analyze communications with Wireshark will help you really understand how

TCP/IP networks function. As the most popular network analyzer tool in the world, the time you spend

honing your skills with Wireshark will pay off when you read technical specs, marketing materials,

security briefings, and more.

This book can also be used by current analysts who need to practice the skills contained in this book.

In essence, this book is for anyone who really wants to know what's happening on their network.

What Prerequisite Knowledge do I Need?

Before you delve into this book (or network analysis in general), you should have a solid

understanding of basic network concepts and TCP/IP fundamentals. For example, you should know the

purpose of a switch, a router, and a firewall. You should be familiar with the concepts of Ethernet

networking, basic wireless networking, and be comfortable with IP network addressing, as well.

There are a few spots in this book where you will need to access the command prompt to set a path to

an application directory or to run basic command-line tools such as *ipconfig/ifconfig*, *ping*, or *trace route*. If you are unfamiliar with these tools, there are plenty of resources on the Internet to show you how they work on various platforms.

You will find a *Network Analyst's Glossary* at the back of the book. This glossary covers many of the terms and technology mentioned in the book. For example, if you aren't familiar with WinPcap when

it's discussed in the book, just flip to the *Network Analyst's Glossary* to learn more.

What Version of Wireshark does this Book Cover?

This book was written using several Wireshark 1.8.x versions and the development version of

Wireshark 1.9.x (which is the development version leading to Wireshark 1.10). Several key features

were added during the development of Wireshark 1.9.x including new name resolution configuration

options and packet comment exporting. These features are documented in this book where appropriate.

Where Can I Get the Book Trace Files?

Probably your first step should be to download the book trace files and other supplemental files from

www.wiresharkbook.com. Click the Wireshark 101 book link and download the entire set of supplemental files. You should follow along with each of the labs to practice the skills covered in each

section.

If you have questions regarding the book or the book web site, please send them to

info@wiresharkbook.com.

Where Can I Learn More about Wireshark and Network

Analysis?

Download or watch Laura's free four-part Wireshark 101 course online at the All Access Pass portal

(*www.lcuportal2.com*).

At the end of this book, we've included a $100 discount code for a one-year All Access Pass training

subscription. The All Access Pass offers live and recorded online training on Wireshark, TCP/IP

communications, troubleshooting, security and more.

For more information on the All Access Pass and other training options, visit Chappell University at

www.chappellU.com.

Foreword by Gerald Combs

Gerald Combs

What's happening on the network?

This is one of those small questions with large answers. For many people it's an important question,

particularly when network problems impact lives and livelihoods.

The first time I saw someone analyze a network they used an oscilloscope. It was the 1980s and

network analysis tools were scarce. I blame hair bands.

The oscilloscope was all we had on hand in our university lab and it showed us the square–ish

electrical pulses that bounced up and down and made up the Ethernet frames flying around our

network. It was a very narrow, limited view of the network, but it was fascinating.

A few years later at a different university I had to troubleshoot the network for our IT department. By

then we had better tools such as tcpdump and a Sniffer which gave us packets instead of pulses. It was

still daunting at first because our network was a zoo of different technologies: Ethernet, FDDI, token

ring, IPX, DECnet, IP, AppleTalk, and more.

It didn't make much sense at first, but it was still fascinating. You could see what was in each message

going across the network along with all the clever methods that people had devised to let computers

talk to each other. That fascination turned into a passion which is still going strong.

Later on I had to answer the question, " *What's happening on the network?* " at an ISP. The nice tools to which I had grown accustomed were unavailable and I felt blind.

I started writing a protocol analyzer and released it as an open source application. Thanks to

contributions from an amazingly talented team of developers and users, it grew into the world's most

popular protocol analyzer.

I think everyone should have a fundamental understanding of computer networks. They are a vital part

of modern society, and as such it's important to know how they work.

It's also important to know that Wireshark won't give you this understanding by itself—no tool will.

Fortunately Wireshark has a vibrant ecosystem that surrounds it, from the development team, to the

user community, to companies that offer Wireshark-related products and services (including my

employer), and to instructors like Laura. The ecosystem is an amazing collection of people who are

keenly interested in protocol analysis and equally interested in helping each other. It is an honor to be

part of it.

Networks may not make a lot of sense at first (they didn't for me), but that's OK. Laura can help you

understand how they work (and how they often don't). She can give you the understanding you need to

get the most out of Wireshark.

What's happening on *your* network?

Gerald Combs

Creator of Wireshark® (formerly *Ethereal*)

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Chapter 0 Skills: Explore Key Wireshark

Elements and Traffic Flows

"There has been one constant in the network traffic aspect of my career, which started in 1998: packet

analysis with Ethereal, later renamed to Wireshark. The Air Force Computer Emergency Response

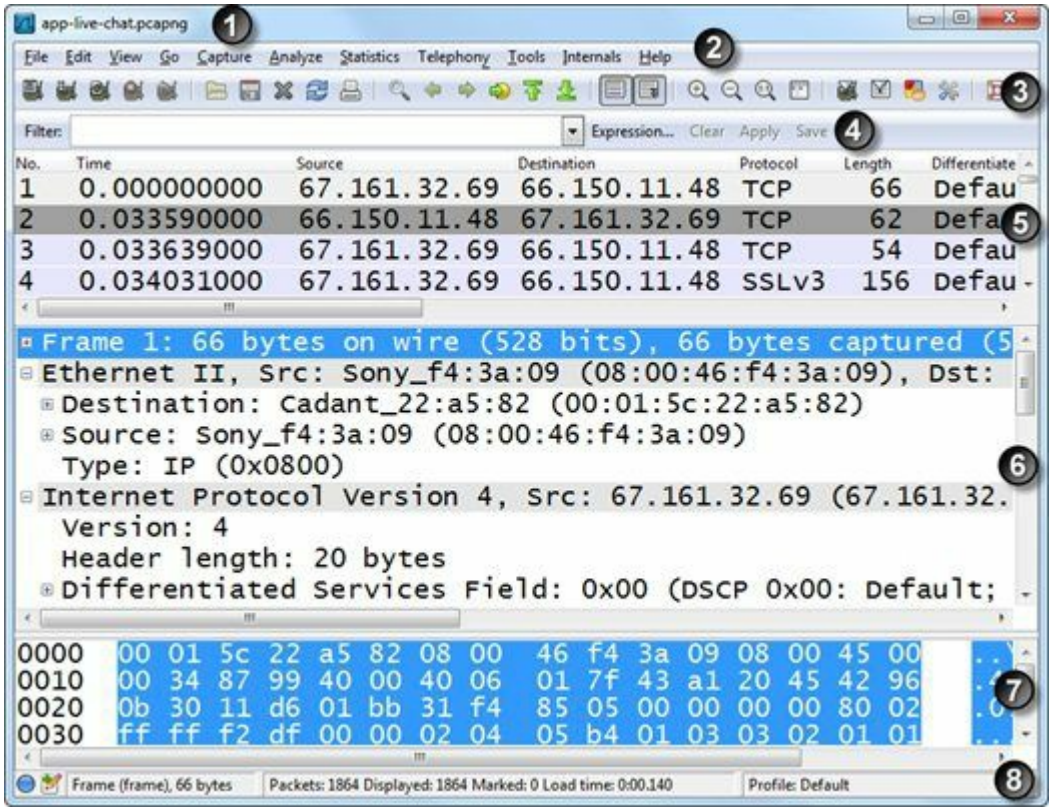
Team (AFCERT), where I learned the trade, was an early adopter of the first versions of the tool.

Today, I couldn't imagine doing protocol inspection without Wireshark, and the project has only

improved over time."

Richard Bejtlich

Chief Security Officer, Mandiant Corporation


app-live-chat.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Length Differentiate
1 0.000000000 67.161.32.69 66.150.11.48 TCP 66 Defau
2 0.033590000 66.150.11.48 67.161.32.69 TCP 62 Defa
3 0.033639000 67.161.32.69 66.150.11.48 TCP 54 Defau
4 0.034031000 67.161.32.69 66.150.11.48 SSLv3 156 Defau
Frame 1: 66 bytes on wire (528 bits), 66 bytes captured (5
Ethernet II, Src: Sony_f4:3a:09 (08:00:46:f4:3a:09), Dst:
Destination: Cadant_22:a5:82 (00:01:5c:22:a5:82)
Source: Sony_f4:3a:09 (08:00:46:f4:3a:09)
Type: IP (0x0800)
Internet Protocol Version 4, Src: 67.161.32.69 (67.161.32.
Version: 4
Header length: 20 bytes
Differentiated Services Field: 0x00 (DSCP 0x00: Default;
0000 00 01 5c 22 a5 82 08 00 46 f4 3a 09 08 00 45 00
0010 00 34 87 99 40 00 40 06 01 7f 43 a1 20 45 42 96
0020 0b 30 11 d6 01 bb 31 f4 85 05 00 00 00 00 80 02
0030 ff ff f2 df 00 00 02 04 05 b4 01 03 03 02 01 01
Frame (frame), 66 bytes
Packets: 1864 Displayed: 1864 Marked: 0 Load time: 0:00.140
Profile: Default
1
2
3
4
5
6
7
8

Quick Reference: Key Wireshark Graphical Interface Elements

1. **Title bar** — trace file name, capture device name, or Wireshark version number

2. **Main menu** — standard menu

3. **Main toolbar** — learn to use this set of icon buttons!

4. **Display filter area** — reduce the amount of traffic you see

5. **Packet List pane** — summary of each frame

6. **Packet Details pane** — dissected frames

7. **Packet Bytes pane** — hex and ASCII details

8. **Status Bar** — access to the Expert, annotations, packet counts, and profiles

0.1. Understand Wireshark's Capabilities

Knowing what Wireshark can do will help you determine if it is the right tool for the job.

Wireshark is the world's most popular network analysis tool with an average of over 500,000

downloads per month. Wireshark is also ranked #1 in the world as a security tool[1]. Named one of the

"Most Important Open-Source Apps of All Time" [2], Wireshark runs on Windows, Mac OS X, and

*NIX. Wireshark can even be run as a Portable App[3].

Wireshark is a free open source software program available at *wireshark.org*. When run on a host that can see a wired or wireless network, Wireshark captures and decodes the network frames, offering an

ideal tool for network troubleshooting, optimization, security (network forensics), and application

analysis. Captured traffic can be saved in numerous trace file formats (defaulting to the new .pcapng

format).

Wireshark's decoding process uses dissectors that can identify and display the various fields and

values in network frames. In many instances, Wireshark's dissectors offer an interpretation of frame

contents as well—a feature that significantly reduces the time required to locate the cause of poor

network performance or to validate security concerns.

The open source development community has created thousands of dissectors to interpret the most

commonly seen applications and protocols on networks. A core set of Wireshark developers is led by

Gerald Combs, the original creator of Ethereal (Wireshark's development name prior to May 2006).

As an open source project, Wireshark's source code is open to anyone for review or enhancement.

Wireshark can be used to easily determine who the top talkers are on the network, what applications

are currently in use, which protocols are supported on a network, whether requests are receiving error

responses, and whether packets are being dropped or delayed along a path. In addition, numerous

filters can be applied to target a specific address (or address range), application, response code,

conversation, keyword, etc.

The Wireshark installation package includes numerous tools used to capture packets at the command

line, merge trace files, split trace files, and more.

Based on SLOCCount (Source Lines of Code Count), created by David A. Wheeler, Wireshark has

over 2.4 million total lines of code (SLOC)[4] and the total estimated cost to develop Wireshark is over $94 million.

The following is a quick list of some tasks that can be performed using Wireshark.

General Analysis Tasks

Find the top talkers on the network

See network communications in "clear text"

See which hosts use which applications

Baseline normal network communications

Verify proper network operations

Learn who's trying to connect to your wireless network

Capture on multiple networks simultaneously

Perform unattended traffic capture

Capture and analyze traffic to/from a specific host or subnet

View and reassemble files transferred via FTP or HTTP

Import trace files from other capture tools

Capture traffic using minimal resources

Troubleshooting Tasks

Create a custom analysis environment for troubleshooting

Identify path, client, and server delays

Identify TCP problems

Detect HTTP proxy problems

Detect application error responses

Graph IO rates and correlate drops to network problems

Identify overloaded buffers

Compare slow communications to a baseline of normal communications

Find duplicate IP addresses

Identify DHCP server or relay agent problems on a network

Identify WLAN signal strength problems

Detect WLAN retries

Capture traffic leading up to (and possibly the cause of) problems

Detect various network misconfigurations

Identify applications that are overloading a network segment

Identify the most common causes of poorly performing applications

Security Analysis (Network Forensics) Tasks

Create a custom analysis environment for network forensics

Detect applications that are using non-standard ports

Identify traffic to/from suspicious hosts

See which hosts are trying to obtain an IP address

Identify "phone home" traffic

Identify network reconnaissance processes

Locate and globally map remote target addresses

Detect questionable traffic redirections

Examine a single TCP or UDP conversation between a client and server

Detect maliciously malformed frames

Locate known keyword attack signatures in your network traffic

Application Analysis Tasks

Learn how applications and protocols work

Graph bandwidth usage of an application

Determine if a link will support an application

Examine application performance after update/upgrade

Detect error responses from a newly installed application

Identify which users are running a particular application

Examine how an application uses transport protocols such as TCP or UDP

WARNING

Before you capture your first packet, ensure you have permission to listen to the network traffic. If you

are an IT staff member, obtain written permission to listen in to network traffic for troubleshooting,

optimization, security, and application analysis. Consult a legal specialist to understand your local

and national laws regarding packet capture on wired and wireless networks.

0.2. Get the Right Wireshark Version

Since you may move from one location to another, from one computer to another, and from one

operating system to another, it's best to know on what systems you can install Wireshark.

Wireshark runs on most of the commonly used operating systems, including Windows, Mac OS X, and

*NIX systems.

All OS versions of Wireshark can be obtained from www.wireshark.org. Click the **Download Wireshark** button and the site will recognize the operating system you are running and highlight the

version of Wireshark that is most appropriate for your OS.

If you are really new to Wireshark, consider downloading, installing, and using the Windows

version—the Windows installation process is the simplest process since it only requires

running a single executable installation file.

Currently, the Windows and Mac OS X installation processes are quite simple since these versions of

Wireshark are available with an installer program (binary package). In the case of Mac OS X you may

be prompted to install XQuartz (graphical interface requirement). The installer program will walk you

through the process to locate XQuartz, if necessary.

In the case of *NIX, however, you must obtain the source and build Wireshark for the operating

system you are using. This process is a bit more complex than just downloading the binary package

and clicking "install." You will need to obtain GTK+ (graphical interface requirement) and libpcap

(packet capture requirement) before you begin to build Wireshark on your system. Since this book is

focused on the functionality of Wireshark, and not the installation process, we refer you to

www.wireshark.org/docs/wsug_html_chunked/ChapterBuildInstall.html[5] for step-by-step installation instructions.

Wireshark also comes preinstalled on a number of forensic tool distributions, such as BackTrack

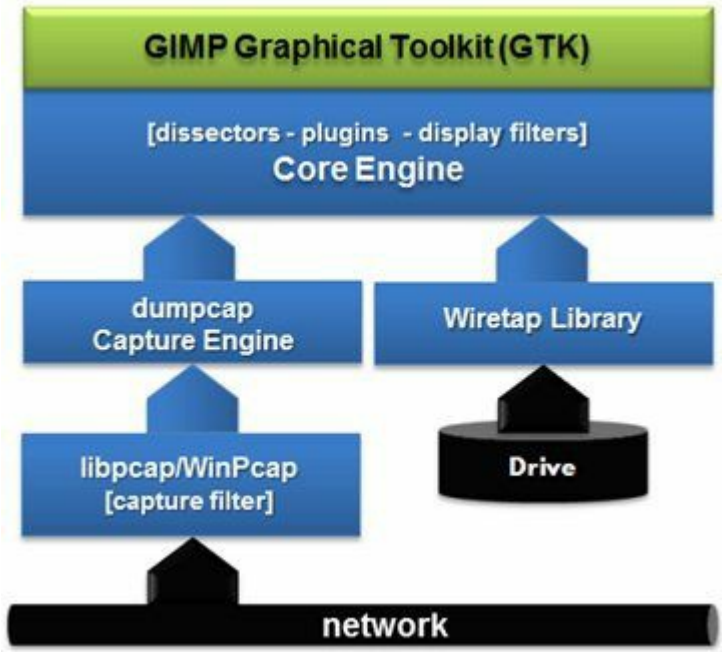
(*www.backtrack-linux.org*), although it may not be the latest version.

The complete list of operating system requirements is available at

www.wireshark.org/docs/wsug_html_chunked/ChIntroPlatforms.html.

*Sign up for the **Wireshark-announce** mailing list at www.wireshark.org/lists/ to be notified when new Wireshark releases are available. You typically want to be up-to-date with*

Wireshark as new releases often include bug and security fixes.



0.3. Learn how Wireshark Captures Traffic

Understanding how Wireshark captures traffic will affect how you use Wireshark's features. In this

section we refer to the elements depicted in Figure 1.

Figure 1. How Wireshark handles traffic from a live capture or from a saved trace file.

The Capture Process Relies on Special Link-Layer Drivers

When your computer connects to a network, it relies on a network interface card (such as an Ethernet

card) and link-layer driver (such as an Atheros PCI-E Ethernet driver) to send and receive packets.

Wireshark also relies on network interface cards and link-layer drivers to pass up traffic for capture

and analysis. Although the network interface cards are the same in both situations, when you use

Wireshark, two special link-layer drivers are commonly used: WinPcap and libpcap. These special

drivers provide access to raw data on the network.

WinPcap is the special link-layer driver used on a Windows host. Libpcap is the special link-layer

driver used on *NIX hosts and OS X.

When you start capturing traffic with Wireshark, a tool called dumpcap is launched to do the actual

capturing. Frames are passed up from the network, through one of these special link-layer drivers

directly into Wireshark's Capture Engine. If you applied a capture filter (only capturing broadcast

traffic for example), the frames that pass through the capture filter are passed up to the Capture

Engine. Capture filters use Berkeley Packet Filtering (BPF) syntax.

For more information on filtering out (excluding) or filtering in (passing on to Wireshark) specific

traffic types, refer to *Reduce the Amount of Traffic You have to Work With.*

The Dumpcap Capture Engine Defines Stop Conditions

The Dumpcap capture engine defines how the capture process runs and the stop conditions. For

example, you can set up a capture to save frames to a set of 50 MB files and automatically stop after 6

files have been written. We refer to these files as trace files.

The current default trace file format is .pcapng (packet capture, next generation).

The new .pcapng format offers the ability to save metadata with a file. In essence, you can

now save annotations (comments) inside your trace file. We will look into this process in

Chapter 7.

The Core Engine is the Goldmine

The Capture Engine passes frames up to the Core Engine. This is where Wireshark's power becomes

evident. Wireshark supports thousands of dissectors that translate the incoming bytes into human-

readable format frames. The dissectors break apart the fields in the frames and often perform analysis

on the content of those fields.

For more information on how Wireshark dissectors work, see *Dissect the Wireshark Dissectors.*

The Graphical Toolkit Provides the User Interface

The GIMP (GNU Image Manipulation Program) graphical toolkit provides the cross-platform

interface for Wireshark. With very few exceptions, you can move seamlessly from a Wireshark

system running on one platform to a Wireshark system running on another platform with no problems.

The basic interface elements are the same.

The Wiretap Library is Used to Open Saved Trace Files

The Wiretap Library is used for the input/output functions for saved trace files. When you open a trace

file (whether captured with Wireshark or another analysis tool), the Wiretap Library delivers the

frames to the Core Engine.

For more information on the Wiretap Library, see *Open Trace Files Captured with Other Tools*.

0.4. Understand a Typical Wireshark

Analysis Session

Although each analysis session is a bit different, there are some basic steps that you should perform

during each analysis session.

The following is a checklist of the most common tasks performed during an analysis session. Consider

using this basic task checklist when you open a trace file.

Determine who is talking in the trace file

See *Find Out Who's Talking to Whom on the Network*

Determine what applications are in use

See *List Applications Seen on the Network*

Filter on the conversation of interest

See *Filter on a Single TCP or UDP Conversation*

Graph the IO to look for drops in throughput

See *Graph Application and Host Bandwidth*

Open the Expert to look for problems

See *Identify TCP Errors*

Determine the round trip time to identify path latency

See *Use Filters to Spot Communication Delays*

Each of these tasks is covered in this book.

Now is the time to start your own checklist of tasks. As you go through the labs in this book,

note the tasks that you'd like to repeat each time a trace file comes in. As with many skills,

practice will pay off.

0.5. Differentiate a Packet from a Frame

You will see both terms used in the world of protocol analysis. The term "packet" is often used as a

blanket term to describe anything sent across a network, but there is a definite difference between

these two terms.

Recognize a Frame

The term "frame" is used when referring to the communication from the Media Access Control

(MAC) layer header (such as an Ethernet header) through the MAC trailer. All communications

between devices use frames. We don't spend a lot of time troubleshooting or analyzing Ethernet

frames, however. There's not a lot to analyze in an Ethernet header or trailer and Ethernet technology

is fairly well implemented and not often the problem. In the world of wireless technology, however,

there is a lot going on in the WLAN header—enough to focus on during a troubleshooting session.

You will not always see the Ethernet trailer when analyzing traffic. Some operating systems do not

support capturing the trailers on Ethernet networks.

Just to make this more confusing, Wireshark adds a "Frame" section to provide extra information

about all actual frames. When you look inside the Packet Details pane, you will see this Frame section

at the top. If you expand that section, you will see time, coloring and other information added to the

actual frame by Wireshark.

The actual frame begins with the second line, labeled "Ethernet II." Wireshark's Frame section only

contains information about the frame (metadata). It does not contain any of the actual contents of the

frame.

Figure 2 indicates the beginning and ending of the actual frame as well as the Frame section that

contains the metadata.

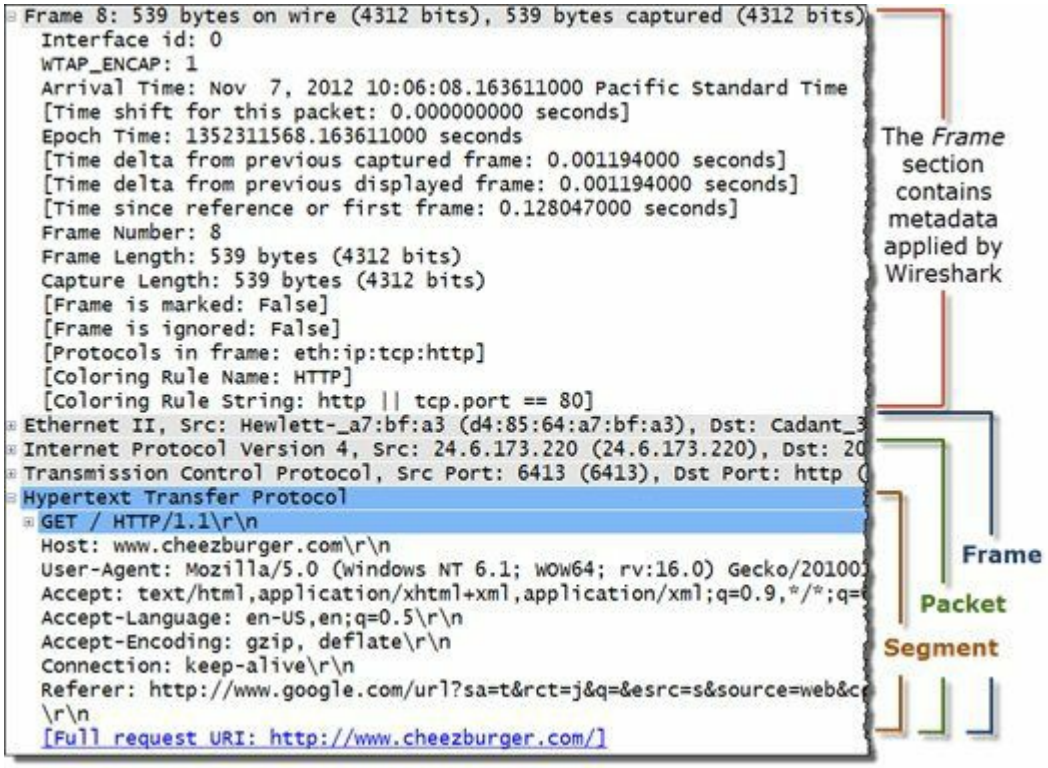
Recognize a Packet

A packet is the stuff that sits inside a MAC frame. In TCP/IP communications, a packet begins at the

IP header and ends just before the MAC trailer. People often refer to network analysis as "packet

analysis"—this naming is due to the fact that the majority of analysis tasks begin at the IP header.

Figure 2 indicates the beginning and ending of the packet.


Frame 8: 539 bytes on wire (4312 bits), 539 bytes captured (4312 bits)
Interface id: 0
WTAP_ENCAP: 1
Arrival Time: Nov 7, 2012 10:06:08.163611000 Pacific Standard Time
[Time shift for this packet: 0.000000000 seconds]
Epoch Time: 1352311568.163611000 seconds
[Time delta from previous captured frame: 0.001194000 seconds]
[Time delta from previous displayed frame: 0.001194000 seconds]
[Time since reference or first frame: 0.128047000 seconds]
Frame Number: 8
Frame Length: 539 bytes (4312 bits)
Capture Length: 539 bytes (4312 bits)
[Frame is marked: False]
[Frame is ignored: False]
[Protocols in frame: eth:ip:tcp:http]
[Coloring Rule Name: HTTP]
[Coloring Rule String: http || tcp.port == 80]
Ethernet II, Src: Hewlett-_a7:bf:a3 (d4:85:64:a7:bf:a3), Dst: Cadant_3
Internet Protocol Version 4, Src: 24.6.173.220 (24.6.173.220), Dst: 20
Transmission Control Protocol, Src Port: 6413 (6413), Dst Port: http (
Hypertext Transfer Protocol
GET / HTTP/1.1\r\n
Host: www.cheezburger.com\r\n
User-Agent: Mozilla/5.0 (Windows NT 6.1; WOW64; rv:16.0) Gecko/20100
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=
Accept-Language: en-US,en;q=0.5\r\n
Accept-Encoding: gzip, deflate\r\n
Connection: keep-alive\r\n
Referer: http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&c
\r\n
[Full request URI: http://www.cheezburger.com/]
The Frame section contains metadata applied by Wireshark
Frame
Packet
Segment

Recognize a Segment

A segment is the stuff that follows a TCP header. That may include an HTTP header or just data.

During establishment of a TCP connection, each TCP peer shares its Maximum Segment Size (MSS)

value. Figure 2 indicates the beginning and ending of the TCP segment.

Figure 2. How will these devices affect the format of the frame along the path?

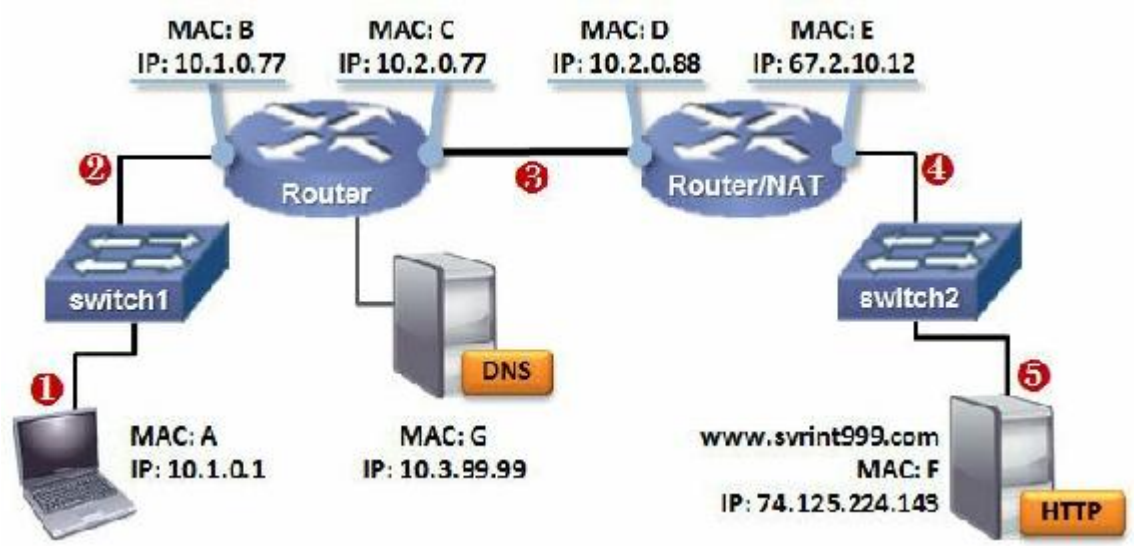
In this book, we use the term "frame" when focusing on the MAC header in communications, or when

referring to a value in the **No.** (number) column (frame number) in the Packet List pane.

Since Wireshark often refers to frames as packets in various menus, we will use Wireshark's

terminology in those cases. For example, the File menu contains an option to "Export Specified

Packets" even though it is exporting frames.



TIP

0.6. Follow an HTTP Packet through a

Network

To be a good analyst, you must know TCP/IP very well. Also key to communications analysis is a

solid understanding of how packets travel through a network and how the traffic is affected by various

network devices.

Let's look at a network path that includes a client, two switches, one standard router, a router that

performs Network Address Translation (NAT) and a server.

Figure 3. How will these devices affect the format of the frame along the path?

In Figure 3, our client sends an HTTP GET request for the main page on the HTTP server. We've used

simple letters to represent the MAC addresses (aka hardware addresses) of the devices.

To know how devices affect the contents of the frame, we will look at how this frame is altered as it

travels through switches, routers, and even a router/NAT device.

There are many times when you will need to capture at more than one location. For example,

when you want to know how a device affects the contents of a frame, you need to capture the

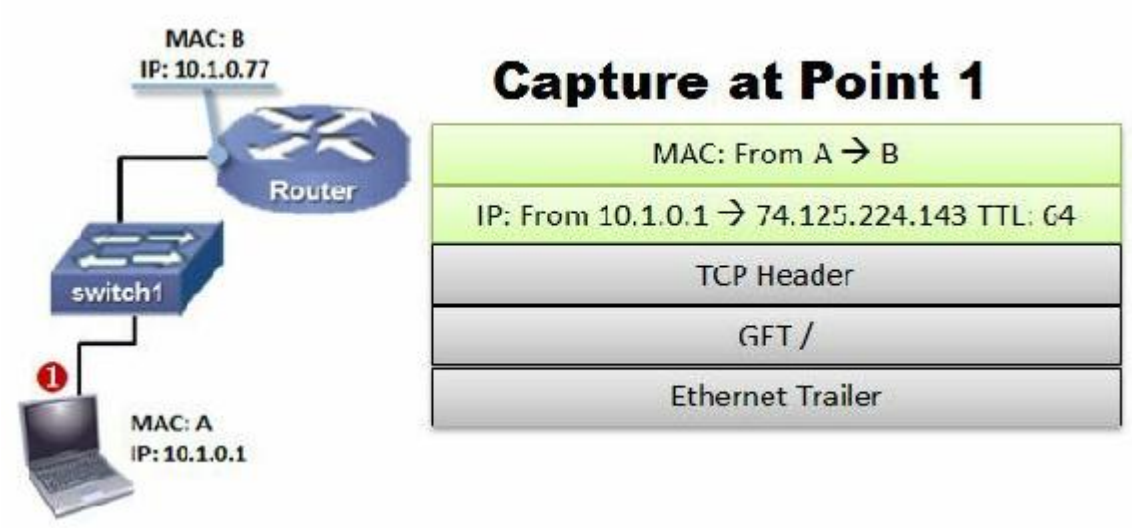
frame both before and after it travels through the device. You may also want to capture traffic

at two locations to determine which internetworking device is dropping packets.

Because capturing at multiple locations is a common analysis task, you should have

Wireshark (or at least dumpcap) loaded on more than one laptop or be prepared to capture

using port spanning or a full-duplex tap. We will cover these capture options in Chapter 2.



Point 1: What Would You See at the Client?

All devices can only send to the hardware address of local machines in MAC headers. This MAC

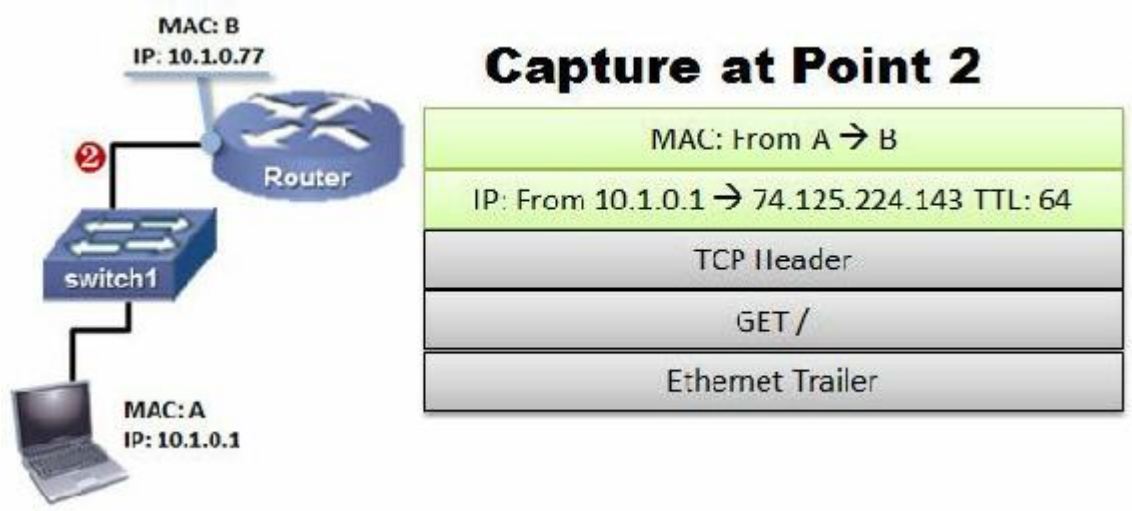
header will be stripped off by the first router along the path—these MAC headers are only temporary

and are used to get the packet to the next hop along a path. In the IP header example above, the packet

is addressed from 10.1.0.1 (client) to 74.125.224.143 (server).

Analyst View: At this point, the Ethernet header of our client's GET request is addressed to the local

router's MAC address (B).



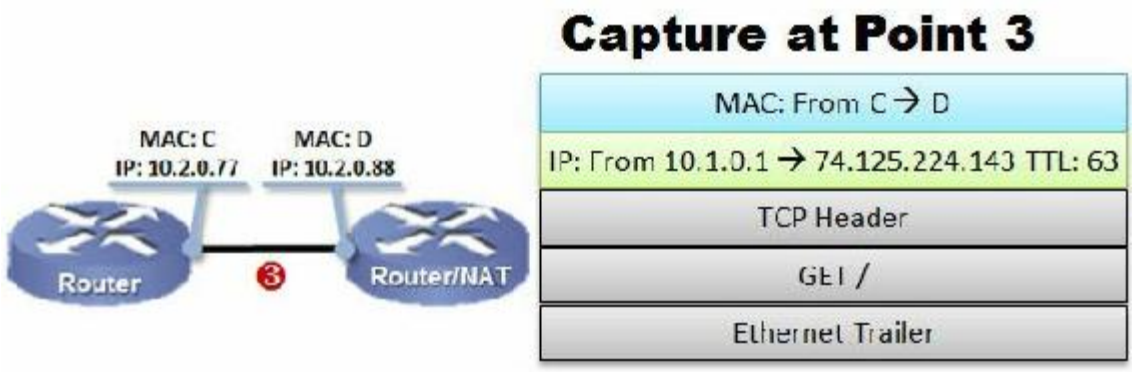
Point 2: What Would You See on the Other Side of the First Switch?

True switches[6] do not affect the contents of the frame. Switch 1 would simply look at the destination MAC address (MAC address B) to determine if that host is connected to one of the switch ports.

When the switch finds the switch port associated with MAC address B, the switch forwards the frame

out the appropriate switch port.

Analyst View: We would see a frame that matches the frame we saw at point 1.



Point 3: What Would You See on the Other Side of the Router?

Upon receipt of the frame, after checking to make sure the frame isn't corrupt and that the frame is

addressed to the router's MAC address, the router strips off the Ethernet header.

The router examines the destination IP address in the packet (it is now considered a packet, not a

frame) and consults its routing tables to see if it knows what to do with the packet. If the router does

not know how to get to the destination IP address (and it doesn't have a default gateway to send the

packet to), the router will drop the packet and send a message back to the originator indicating there is

a routing problem. We can capture these error messages with Wireshark and detect which router is

unable to forward our packets to the destination.

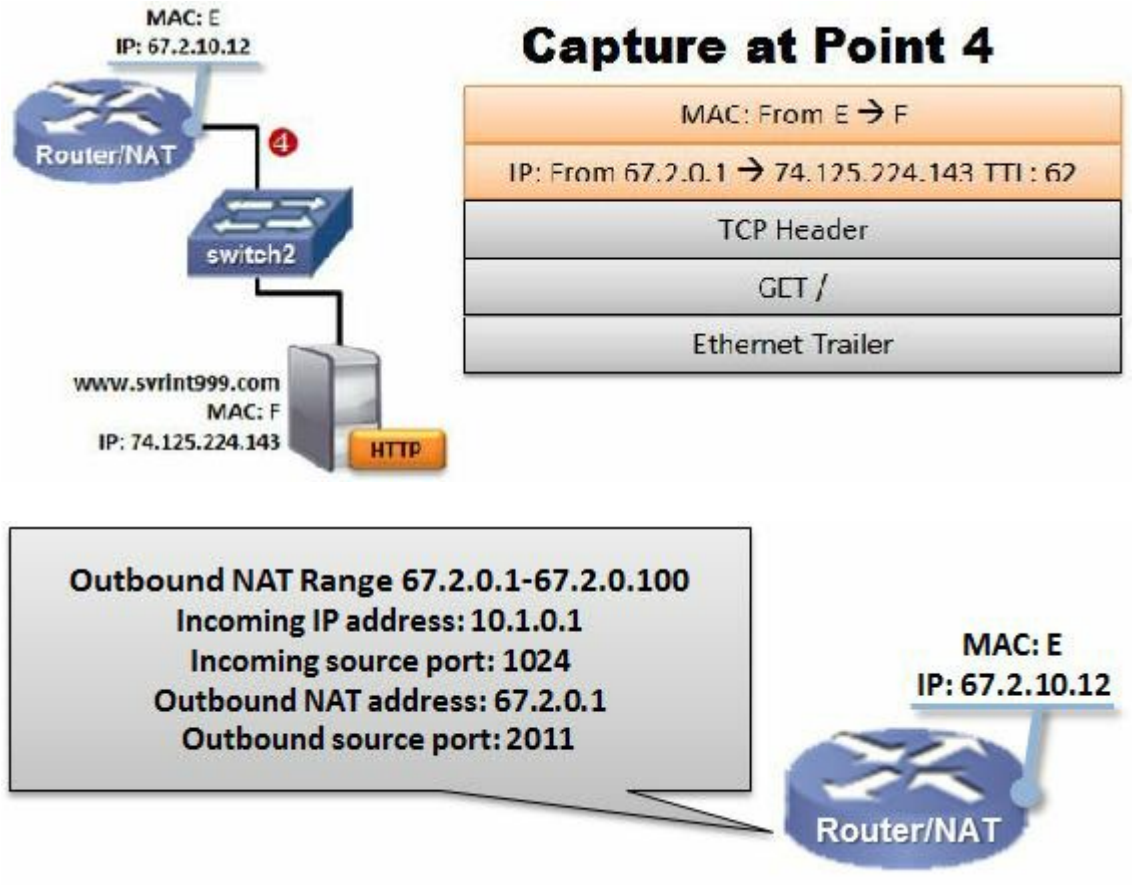
If the router has the information required to forward the packet, it decrements the IP header Time to

Live (hop count) field value by 1 and applies a new Ethernet header to the packet before sending it on

to the router/NAT device.

Analyst View: We would see a new Ethernet header (from C to D) and an IP header Time to Live value

that has been decreased by 1.



Point 4: What Would You See on the Other Side of the

Router/NAT Device?

The router/NAT device goes through the same routing process as the previous router before

forwarding the packet. Additionally, the router/NAT device changes the source IP address (network

address translation) and source port number while making note of the original source IP address and

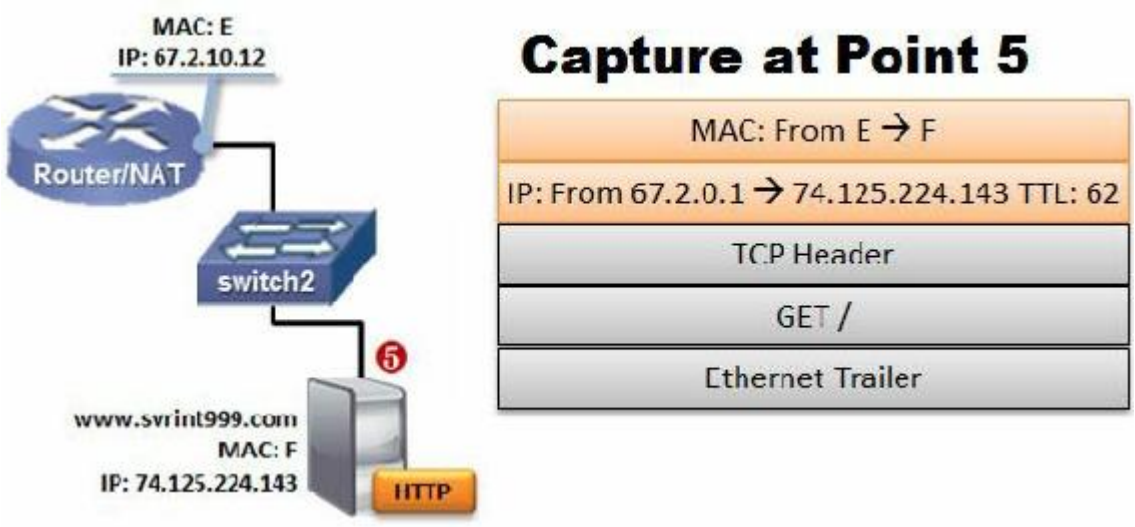
source port number. The router/NAT device associates this information with the newly assigned

outbound IP address and port number.

Analyst View: We would see a new Ethernet header (from E to F) and an IP header Time to Live value

that has been decreased by 1. In addition, we would see that the source IP address and source port

number has changed.



Point 5: What Would You See at the Server?

At this point we should see the same frame that we saw at Point 4. Remember, switches should not

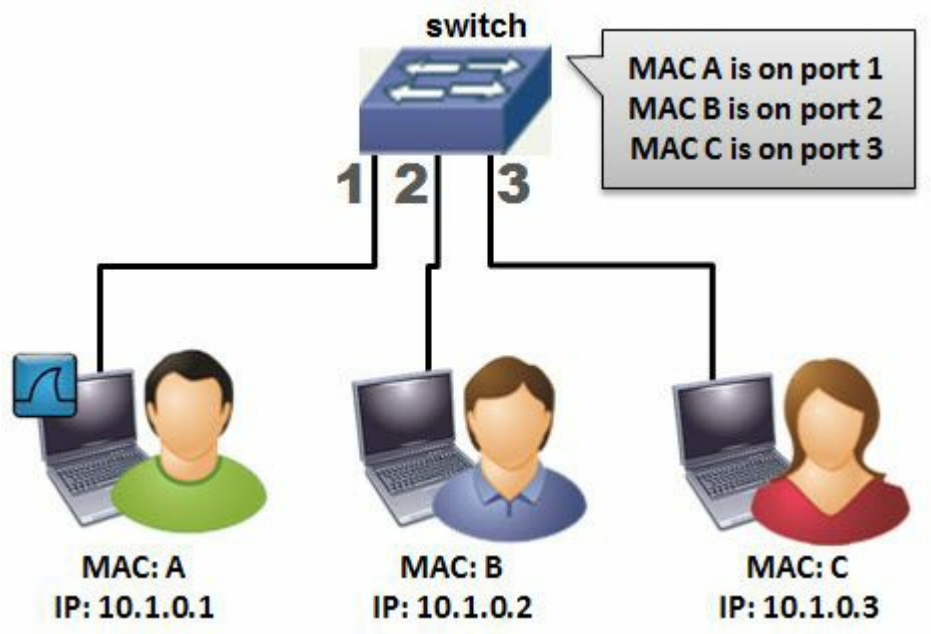
alter the contents of a frame.

Where You Capture Traffic Matters

If you capture at Point 1, 2, or 3, you cannot determine the MAC address of the server. Likewise, if

you capture at Point 3, 4, or 5, you cannot determine the MAC address of the client. If you capture at

point 5, you cannot tell the actual IP address of the client, either.



TIP

Beware of Default Switch Forwarding

Remember, switches forward frames based on MAC address. If you'd connected a Wireshark system

to either of the switches in Figure 3, you would not have seen any of the traffic between our HTTP

client and HTTP server. The switches would only forward broadcast, multicasts, and traffic destined to

your Wireshark system's MAC address down your port[7].

Switches do not alter the MAC addresses or the IP addresses of the traffic, but they can be a major

roadblock in network analysis.

Consider the example shown in Figure 4. We loaded Wireshark on the machine connected to switch

port 1. We have a problem if we want to listen to the traffic between the two other devices on the

network. The switch is not going to forward this down our port—it's not addressed to our MAC

address.

Figure 4. Switches can affect the amount of traffic you see.

It is this limitation that causes us to figure out other methods for listening in on network traffic. We

will look at our options in *Identify the Best Capture Location to Troubleshoot Slow Browsing or File*

Downloads.

Plan and test your capture methods in advance. It's not a fun process to start testing capture

methods when all hell breaks loose on the network and users, their managers, your manager,

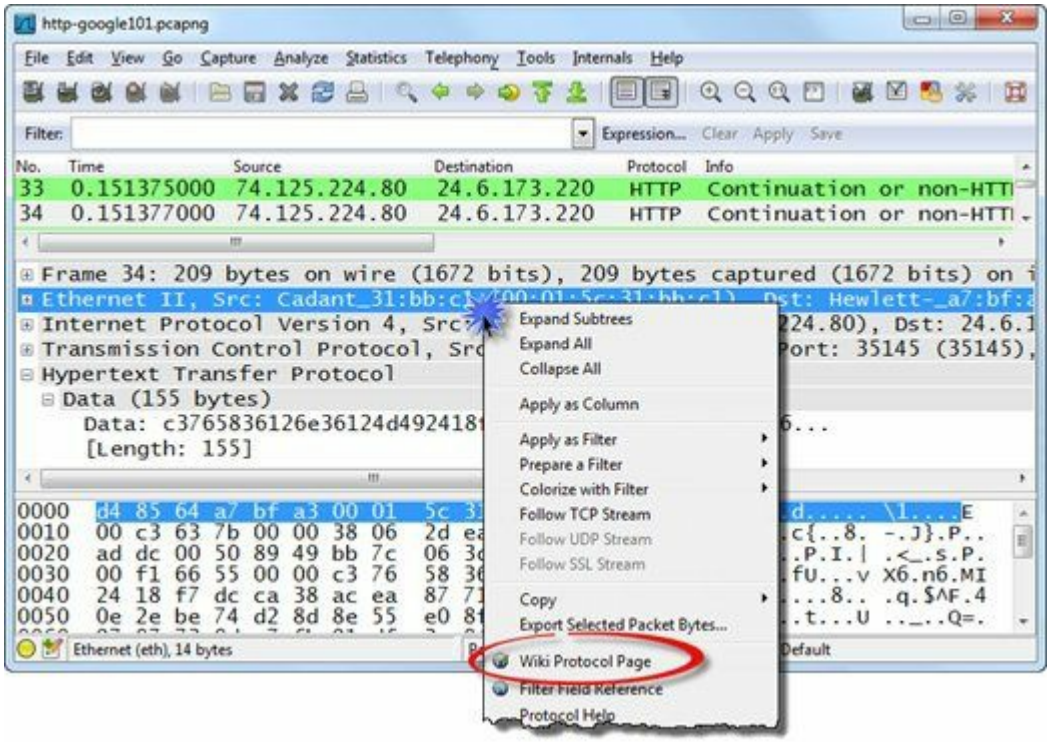
and the CEO are pounding on your office door or encroaching in your cubicle air space. Be

prepared–be practiced.

0.7. Access Wireshark Resources

Eventually you will hit a problem that you just can't solve. Whether it is a problem in Wireshark

functionality or packet structures, you can find assistance in several key places on the Internet.


http-google101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Info
33 0.151375000 74.125.224.80 24.6.173.220 HTTP Continuation or non-HTTI
34 0.151377000 74.125.224.80 24.6.173.220 HTTP Continuation or non-HTTI
Frame 34: 209 bytes on wire (1672 bits), 209 bytes captured (1672 bits) on i
Ethernet II, Src: Cadant_31:bb:c1
Internet Protocol Version 4, Src:
Transmission Control Protocol, Src
Hypertext Transfer Protocol
Data (155 bytes)
Data: c3765836126e36124d492418
[Length: 155]
0000 d4 85 64 a7 bf a3 00 01 5c 3
0010 00 c3 63 7b 00 00 38 06 2d ea
0020 ad dc 00 50 89 49 bb 7c 06 3c
0030 00 f1 66 55 00 00 c3 76 58 36
0040 24 18 f7 dc ca 38 ac ea 87 71
0050 0e 2e be 74 d2 8d 8e 55 e0 81
Ethernet (eth), 14 bytes
Default
Expand Subtrees
Expand All
Collapse All
Apply as Column
Apply as Filter
Prepare a Filter
Colorize with Filter
Follow TCP Stream
Follow UDP Stream
Follow SSL Stream
Copy
Export Selected Packet Bytes...
Wiki Protocol Page
Filter Field Reference
Protocol Help

Use the Wireshark Wiki Protocol Pages

Wireshark offers support through a series of Wiki protocol pages.

Visit wiki.wireshark.org to see all the Wiki information related to Wireshark. You can also add the protocol or application name to the URL for assistance on a protocol. For example, you can type

wiki.wireshark.org/Ethernet[8].

You can also get to these pages by right-clicking on any protocol displayed inside a frame, as shown

in Figure 5. Wireshark detects the protocol selected and launches the related Wiki page.

Figure 5. Right-click on any protocol shown in the Packet Details pane to launch the related Wiki protocol page. [http-google101.pcapng]

Get Your Questions Answered at *ask.wireshark.org*

Gerald Combs, creator of Wireshark, opened a Q&A forum for Wireshark users (shown in Figure 6).

Visit *ask.wireshark.org* to pose your questions to the Wireshark community. You must register for a free account to post a question here.

Figure 6. Use the Search function (7) to look for key words related to your question at ask.wireshark.org.

The following lists the key areas on *ask.wireshark.org.*

1. **Questions tab**—Click to return to the All Questions page (shown above).

2. **Tags tab**—Click to see the list of tags related to questions—click on tags related to your topic of

interest to see if there is helpful information there.

3. **Users tab**—Click to see the users who participate in the Q&A forum—this area also includes

their status in badge colors, counts, and administrative status (diamonds).

4. **Badges tab**—Click to see how many contributors have achieved recognition for their

participation in the Q&A forum.

5. **Unanswered tab**—Click to see questions that are still considered unanswered. Unfortunately,

many Q&A participants do not mark questions "answered" even though they have been.

6. **Ask a Question tab**—Click to ask your question. If you don't have a free account here yet, your

question will be saved as you create an account and login with your new credentials.

7. **Search area and button**—Search for the topic you are interested in first. This is a great place to

start.

8. **Vote count**—Forum users can vote on (like/unlike) questions.

9. **Answer count**—This number indicates how many answers have been submitted to a question.

10. **View count**—This number indicates how many times a question has been viewed. This is a great

indicator to determine how "hot" a topic is.

11. **Question title (hyperlink) and tags**—Click on the question title to jump to the question page.

The tags indicate the topic(s) covered in the question.

12. **Jump to buttons**—Click on any of these buttons to jump to the list of active questions, newest

questions, or questions that have the most votes.

13. **Question activity age and contributor information**—This area indicates how old a question is

(based on last activity such as answer, comment, or even just posting the question), who

contributed to the question most recently, and information about that last contributor. The

contributor information includes the Karma level (level of acquired trust in the forum) and their

administrative levels.

For more information on the Q&A forum, visit *ask.wireshark.org/faq/*.

Note: During the outlining stages of this book, we pulled up the most active questions and the hottest

topics on the Q&A Forum. That list, along with years of experience teaching Wireshark techniques

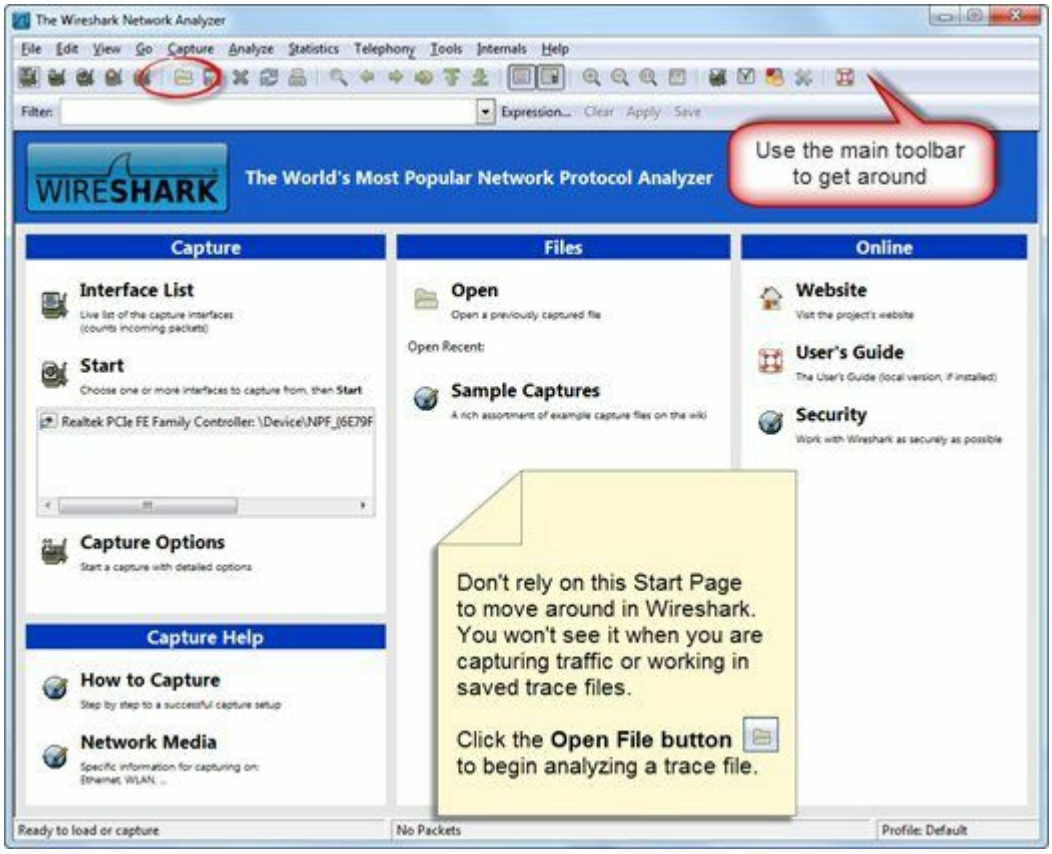
and analyzing network traffic, led to the skills included in this book.

0.8. Analyze Traffic Using the Main

Wireshark View

You don't always need to do a deep dive into the traffic to understand what's going on. A quick look at

the main Wireshark window may be all you need to find the cause or culprit.


The Wireshark Network Analyzer
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
WIRESHARK
The World's Most Popular Network Protocol Analyzer
Use the main toolbar to get around
Capture
Interface List
Start
Realtek PCIe FE Family Controller: \Device\NPF_{6E79F
Capture Options
Capture Help
How to Capture
Network Media
Files
Open
Open Recent:
Sample Captures
Online
Website
User's Guide
Security
Don't rely on this Start Page to move around in Wireshark. You won't see it when you are capturing traffic or working in saved trace files.
Click the Open File button to begin analyzing a trace file.
Ready to load or capture
No Packets
Profile: Default

Open a Trace File (Using the Main Toolbar, Please)

When launched, Wireshark displays a Start Page. Although there are many functions available on the

Start Page, the fastest way to navigate in Wireshark is though the main menu and main toolbar. Click

the **File Open** button on the main toolbar (circled in Figure 7). Open ***http-google101.pcapng***

(available at [*www.wiresharkbook.com.*](http://www.wiresharkbook.com.)

Figure 7. The Start Page appears when you launch Wireshark. Instead, use the main toolbar to navigate in Wireshark.

This trace file contains the traffic between a client and the *www.google.com* server when someone

opens the main web site page. If you capture your own traffic to *www.google.com*, it may look quite

different. Your traffic will contain different MAC and IP addresses and you may have some elements

of the Google site cached (on disk). In the case of cached content, you will load portions of the web

site page from disk—you will not see the cached content being sent from the server in the trace file.

We will work with this trace file as we explore the various elements of the Wireshark main view.

Know When You Must Use the Main Menu

We all know how to use menus. The key is *when* to use the main menu (Figure 8) and *where* to find

what you're looking for. Many of Wireshark's functions are available through the right-click method

or the main toolbar (also referred to as the icon toolbar).

Figure 8. All functions in the Go and Capture menu items can be done faster using the main toolbar.

The following list highlights the reasons you may need to use the main menu instead of the main

toolbar.

File—open file sets, save subsets of packets, export HTTP objects

Edit—clear all marked packets, ignored packets, and time references

View—view/hide toolbars and panes, edit the **Time** column setting, reset coloring

Analyze—create display filter macros, see enabled protocols, save forced decodes

Statistics—build graphs and open statistics windows for various protocols

Telephony—perform all telephony-related functions (graphs, charts, playback)

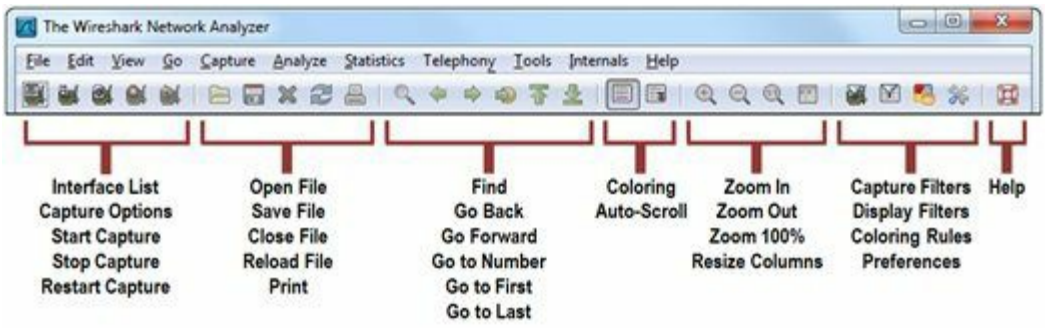
Tools—build firewall rules from packet contents, access the Lua scripting tool

Internals—view the dissector tables and a list of supported protocols

Help—learn where Wireshark stores global and personal configuration files

Again, this list focuses on things you need in the main menu. Become an efficient analyst by finding

the fastest ways to perform tasks.



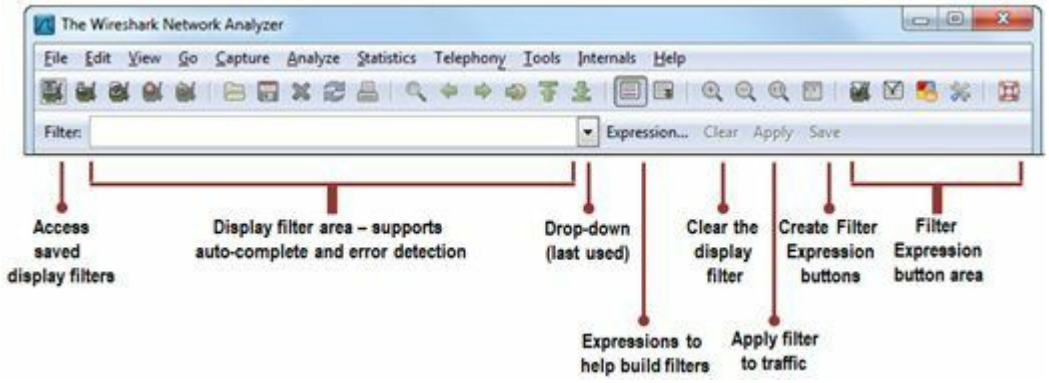
Learn to Use the Main Toolbar Whenever Possible

You can work very efficiently by clicking on the buttons on the main toolbar to open files and access

filters, coloring rules, and preferences. In this book we use most of the key functions on the main

toolbar. These functions are listed in Figure 9.

Figure 9. Become familiar with the main toolbar functions—this is the fastest way to work in Wireshark.


The Wireshark Network Analyzer
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
Access saved display filters
Display filter area – supports auto-complete and error detection
Drop-down (last used)
Clear the display filter
Create Filter Expression buttons
Filter Expression button area
Expressions to help build filters
Apply filter to traffic

Master the Filter Toolbar

We use display filters to pull the "needle out of the haystack." When you have thousands or hundreds

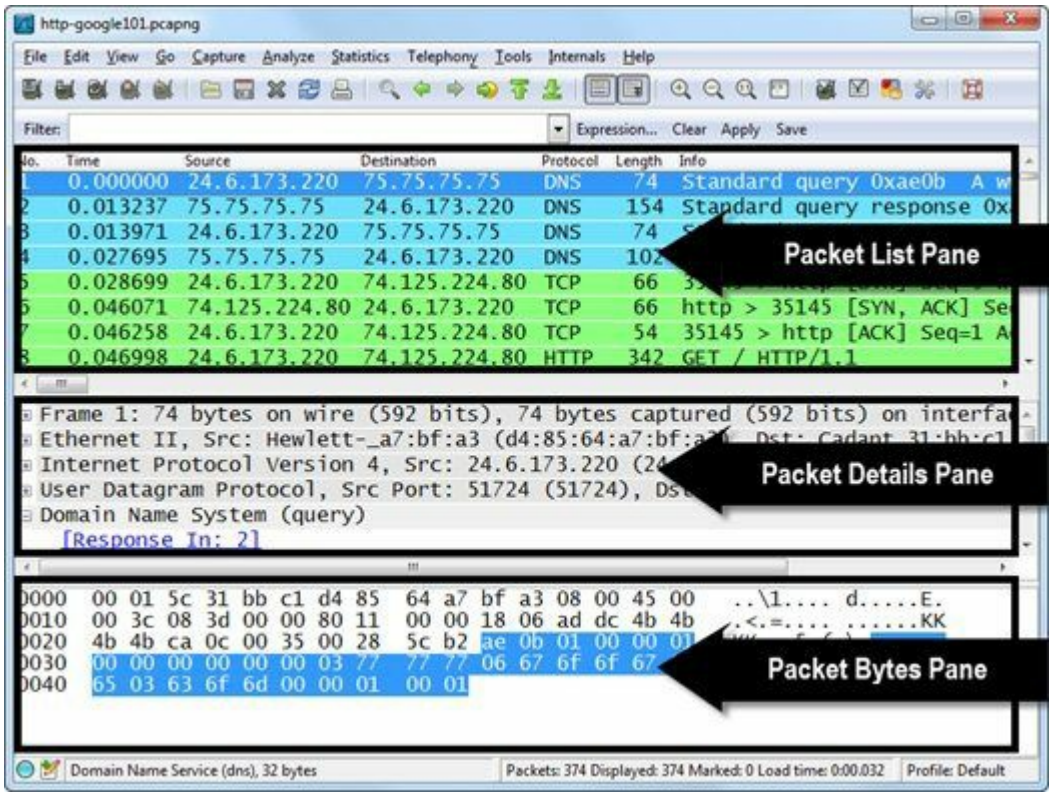
of thousands of packets to look through, use display filters to see traffic that is related to the task at

hand. For example, if you are troubleshooting someone's web browsing session, you can use a display

filter to remove email sessions or virus update traffic from view.

Figure 10 highlights the purpose of each section of the filter toolbar.

Figure 10. Learn to use the display filter toolbar to save time analyzing traffic.


http-google101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
1 0.000000 24.6.173.220 75.75.75.75 DNS 74 Standard query 0xae0b A w
2 0.013237 75.75.75.75 24.6.173.220 DNS 154 Standard query response 0x
3 0.013971 24.6.173.220 75.75.75.75 DNS 74
4 0.027695 75.75.75.75 24.6.173.220 DNS 102
5 0.028699 24.6.173.220 74.125.224.80 TCP 66
6 0.046071 74.125.224.80 24.6.173.220 TCP 66 http > 35145 [SYN, ACK] Se
7 0.046258 24.6.173.220 74.125.224.80 TCP 54 35145 > http [ACK] Seq=1 A
8 0.046998 24.6.173.220 74.125.224.80 HTTP 342 GET / HTTP/1.1
Packet List Pane
Frame 1: 74 bytes on wire (592 bits), 74 bytes captured (592 bits) on interfa
Ethernet II, Src: Hewlett-_a7:bf:a3 (d4:85:64:a7:bf:a3), Dst: Cadant_31:bb:c1
Internet Protocol Version 4, Src: 24.6.173.220 (24
User Datagram Protocol, Src Port: 51724 (51724), Ds
Domain Name System (query)
[Response In: 2]
Packet Details Pane
0000 00 01 5c 31 bb c1 d4 85 64 a7 bf a3 08 00 45 00 ..\1.... d.....E.
0010 00 3c 08 3d 00 00 80 11 00 00 18 06 ad dc 4b 4b .<.=.... ......KK
0020 4b 4b ca 0c 00 35 00 28 5c b2 ae 0b 01 00 00 01
0030 00 00 00 00 00 00 03 77 77 77 06 67 6f 6f 67
0040 65 03 63 6f 6d 00 00 01 00 01
Packet Bytes Pane
Domain Name Service (dns), 32 bytes
Packets: 374 Displayed: 374 Marked: 0 Load time: 0:00.032
Profile: Default

Summarize the Traffic Using the Packet List Pane

Wireshark has three panes (windows)—the Packet List pane, the Packet Details pane, and the Packet

Bytes pane.

The Packet List pane is the top pane, as shown in Figure 11.

Figure 11. When you select a frame in the Packet List pane, the Packet Details pane and Packet Bytes pane provide additional information on the selected packet. [http–google101.pcapng]

Scroll through the Packet List pane to see which hosts are communicating, the protocols or

applications in use, and general information about the frames. Wireshark colors the frames based on a

set of coloring rules. For more information on coloring rules, see *Identify Applied Coloring Rules*.

You can add columns to the Packet List pane and sort on any column. This sorting ability can help you

find similar packets or large delays in the trace file. By default, the Packet List pane is sorted by the

frame number column (" **No.** " column on the far left side).

Figure 12 shows the Packet List pane of *http-google101.pcapng*. Each packet in the trace file contains

information in the default columns listed below.

Number ("No.") column—Each frame is assigned a number. By default, traffic is sorted on the

No. column from low to high. You can sort the Packet List pane by clicking on the desired

column heading. If you change the sort order and want to return to the default look of the Packet

List pane, sort on this column.

Time column—By default, Wireshark shows when each frame arrived compared to the first

frame in the **Time** column. We will use this column to find delays in *Detect Latency Problems by*

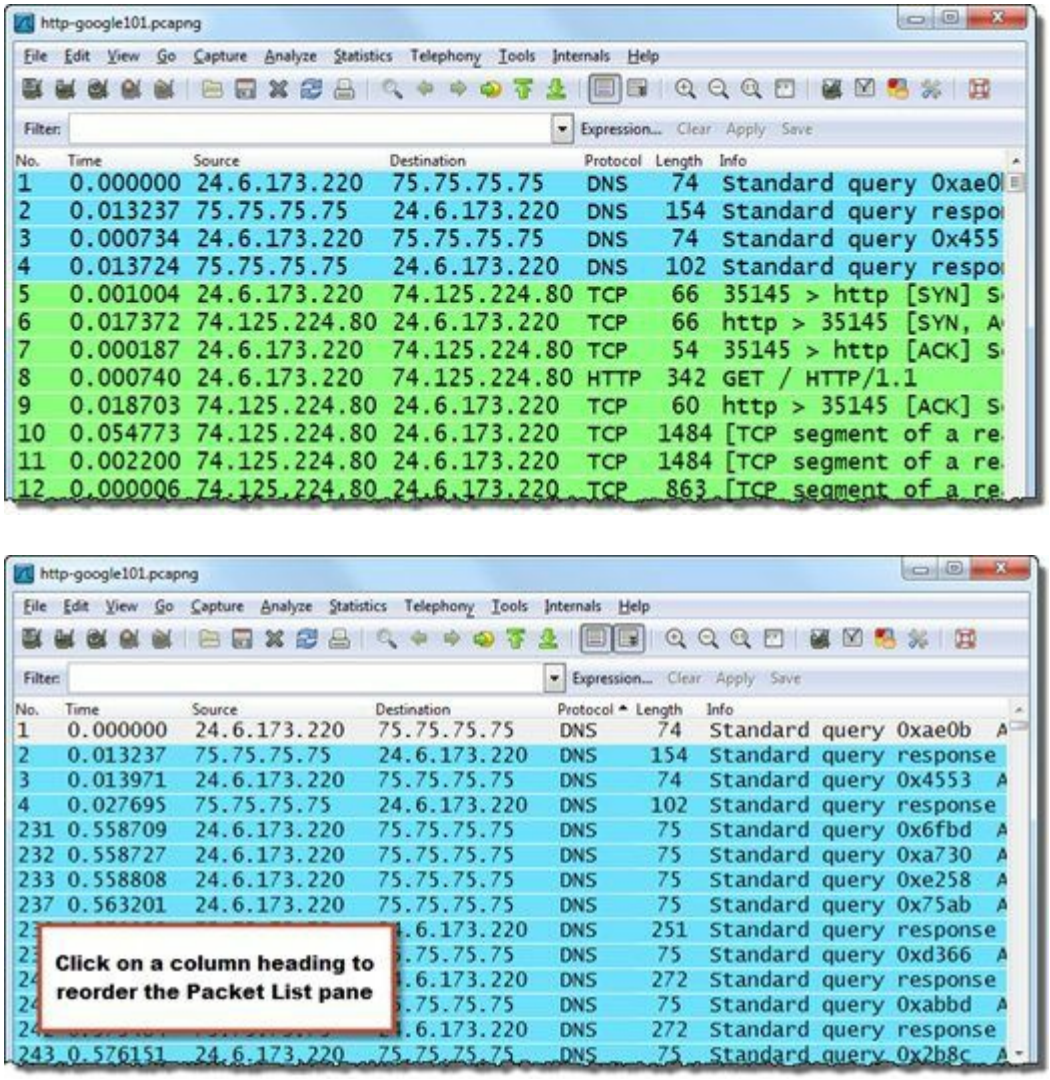
Changing the Time Column Setting.

Source and Destination columns—The **Source** and **Destination** columns show the highest layer

address available in each frame. Some frames only have a MAC address (ARP packets, for

example) so those MAC addresses will be displayed in the **Source** and **Destination** columns. In

Figure 12, we see that all of our frames have IP addresses shown in the Source and Destination



http-google101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
1 0.000000 24.6.173.220 75.75.75.75 DNS 74 Standard query 0xae0b A
2 0.013237 75.75.75.75 24.6.173.220 DNS 154 Standard query response
3 0.013971 24.6.173.220 75.75.75.75 DNS 74 Standard query 0x4553 A
4 0.027695 75.75.75.75 24.6.173.220 DNS 102 Standard query response
231 0.558709 24.6.173.220 75.75.75.75 DNS 75 Standard query 0x6fbd A
232 0.558727 24.6.173.220 75.75.75.75 DNS 75 Standard query 0xa730 A
233 0.558808 24.6.173.220 75.75.75.75 DNS 75 Standard query 0xe258 A
237 0.563201 24.6.173.220 75.75.75.75 DNS 75 Standard query 0x75ab A
Click on a column heading to reorder the Packet List pane
243 0.576151 24.6.173.220 75.75.75.75 DNS 75 Standard query 0x2b8c A

columns.

Protocol column—Wireshark displays the last dissector applied to the frame. This is a great

place to look if you're trying to figure out what applications are in use. In Figure 12, we see DNS,

TCP, and HTTP listed in this column.

Length column—This column indicates the total length of each frame. We can easily detect if an

application uses itty bitty stinkin' packet sizes by looking at this column.

Info column—This column provides basic information about the frame. Look at this column as

you scroll through this trace file. You will see many DNS queries and responses, many HTTP

GET requests, and data packets as the user loads the main Google page.

Figure 12. The seven default columns of the Packet List pane. [http-google101.pcapng]

Sort Columns in the Packet List Pane

As mentioned earlier, you can sort the Packet List pane by clicking on the desired column heading.

For example, if you click on the **Protocol** column heading when viewing *http–google101.pcapng*,

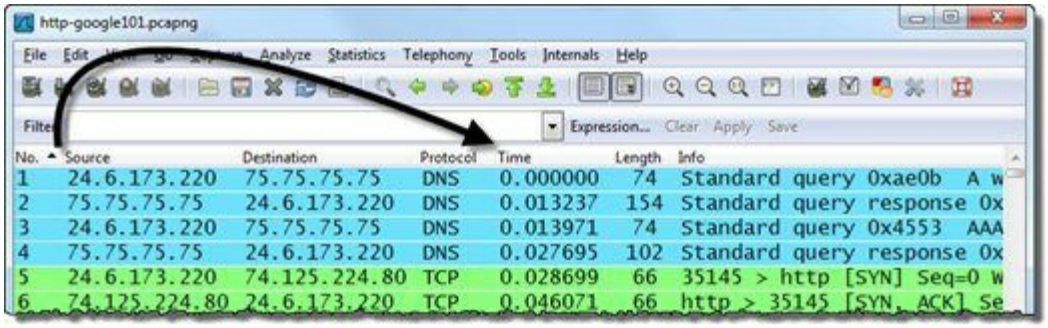
Wireshark reorders the frames as DNS, HTTP, and TCP (ascending alphabetically), as shown in Figure

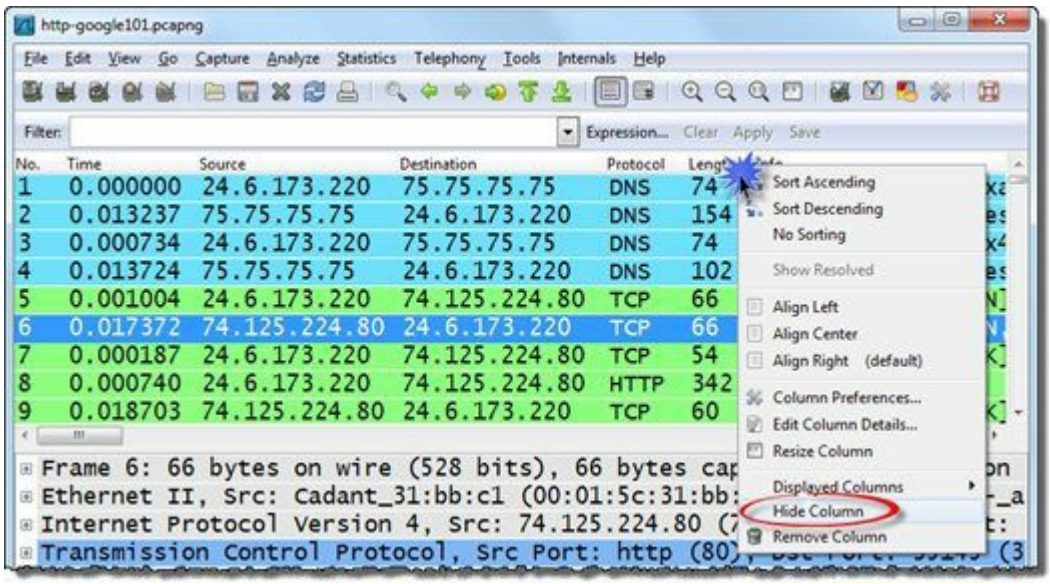
13.

Click the Number (" **No.** ") column heading once to reorder the Packet List pane in its original order (from low to high).

Figure 13. Click once on any column heading to sort from low to high —click again to sort from high to low. [http–

google101.pcapng]


http-google101.pcapng
File Edit Analyze Statistics Telephony Tools Internals Help
Expression... Clear Apply Save
No. Source Destination Protocol Time Length Info
1 24.6.173.220 75.75.75.75 DNS 0.000000 74 Standard query 0xae0b A w
2 75.75.75.75 24.6.173.220 DNS 0.013237 154 Standard query response 0x
3 24.6.173.220 75.75.75.75 DNS 0.013971 74 Standard query 0x4553 AAA
4 75.75.75.75 24.6.173.220 DNS 0.027695 102 Standard query response 0x
5 24.6.173.220 74.125.224.80 TCP 0.028699 66 35145 > http [SYN] Seq=0 W
6 74.125.224.80 24.6.173.220 TCP 0.046071 66 http > 35145 [SYN, ACK] Se


http-google101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: Expression... Clear Apply Save
No. Time Source Destination Protocol
1 0.000000 24.6.173.220 75.75.75.75 DNS
2 0.013237 75.75.75.75 24.6.173.220 DNS
3 0.000734 24.6.173.220 75.75.75.75 DNS
4 0.013724 75.75.75.75 24.6.173.220 DNS
5 0.001004 24.6.173.220 74.125.224.80 TCP
6 0.017372 74.125.224.80 24.6.173.220 TCP
7 0.000187 24.6.173.220 74.125.224.80 TCP
8 0.000740 24.6.173.220 74.125.224.80 HTTP
9 0.018703 74.125.224.80 24.6.173.220 TCP
Sort Ascending
Sort Descending
No Sorting
Show Resolved
Align Left
Align Center
Align Right (default)
Column Preferences...
Edit Column Details...
Resize Column
Displayed Columns
Hide Column
Remove Column
Frame 6: 66 bytes on wire (528 bits), 66 bytes cap
Ethernet II, Src: Cadant_31:bb:c1 (00:01:5c:31:bb:
Internet Protocol Version 4, Src: 74.125.224.80 (7
Transmission Control Protocol, Src Port: http (80)

Reorder the Columns

You can change the location of columns by clicking and dragging on a column heading to move it left

or right. In Figure 14 we moved the **Time** column to the right.

Figure 14. Just click and drag column headings left or right to reorder columns. [http–google101.pcapng]

Right-Click on Column Headings to Hide, Display, Rename, and Remove

Columns

Right-click on any column heading to view your options in a drop-down menu. Select **Hide Column**

to remove the column from view, as shown in Figure 15. To view the column again, right-click on any

column heading, select **Displayed Columns**, and select the column name[9].

Figure 15. Right-click on any column heading to view the column options menu. When you do not want to see a column, select

***Hide Column**. [http-google101.pcapng]*

Right-Click in the Packet List Pane to View Available Options

Many of Wireshark's windows and views support right-click functions. Right-click on any packet in

the Packet List pane to see what's available, as shown in Figure 16.

In this book, we use this right-click functionality to apply filters, colorize traffic, reassemble traffic

(follow streams), force Wireshark to dissect something in a different way, and more.

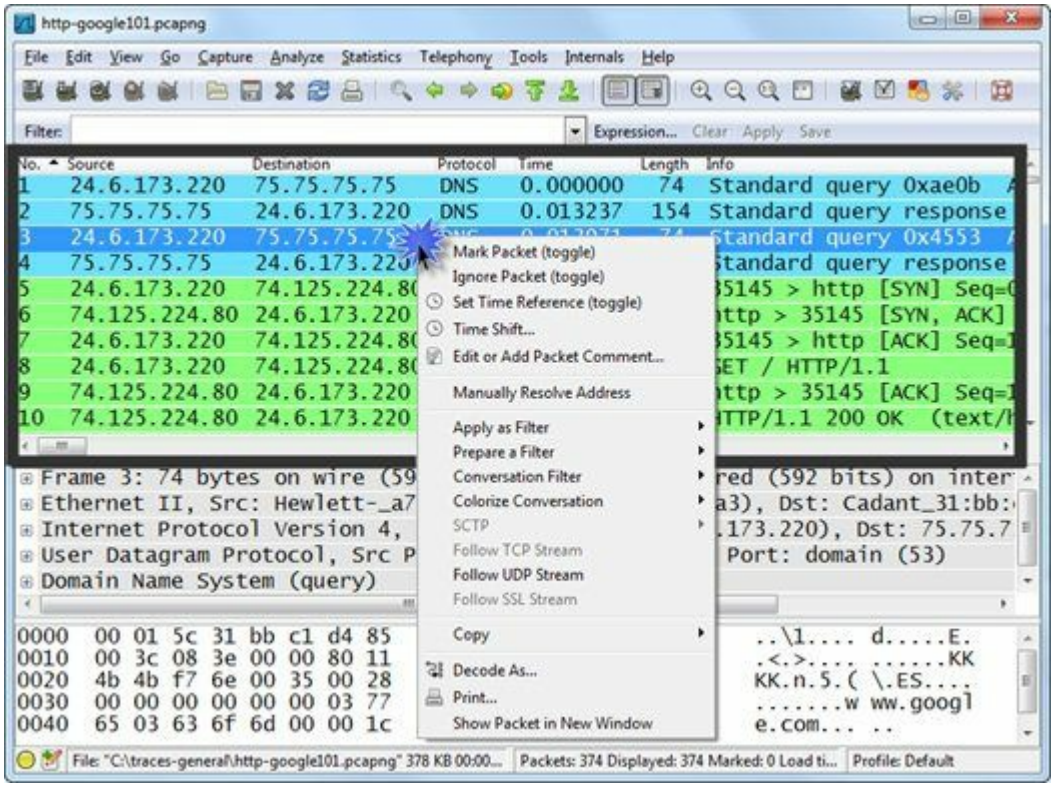

http-google101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Source Destination Protocol Time Length Info
1 24.6.173.220 75.75.75.75 DNS 0.000000 74 Standard query 0xae0b
2 75.75.75.75 24.6.173.220 DNS 0.013237 154 Standard query response
3 24.6.173.220 75.75.75.75
4 75.75.75.75 24.6.173.220
5 24.6.173.220 74.125.224.80
6 74.125.224.80 24.6.173.220
7 24.6.173.220 74.125.224.80
8 24.6.173.220 74.125.224.80
9 74.125.224.80 24.6.173.220
10 74.125.224.80 24.6.173.220
Mark Packet (toggle)
Ignore Packet (toggle)
Set Time Reference (toggle)
Time Shift...
Edit or Add Packet Comment...
Manually Resolve Address
Apply as Filter
Prepare a Filter
Conversation Filter
Colorize Conversation
SCTP
Follow TCP Stream
Follow UDP Stream
Follow SSL Stream
Copy
Decode As...
Print...
Show Packet in New Window
Frame 3: 74 bytes on wire (59
Ethernet II, Src: Hewlett-_a7
Internet Protocol Version 4,
User Datagram Protocol, Src P
Domain Name System (query)
0000 00 01 5c 31 bb c1 d4 85
0010 00 3c 08 3e 00 00 80 11
0020 4b 4b f7 6e 00 35 00 28
0030 00 00 00 00 00 00 03 77
0040 65 03 63 6f 6d 00 00 1c
File: "C:\traces-general\http-google101.pcapng" 378 KB 00:00...
Packets: 374 Displayed: 374 Marked: 0 Load ti...
Profile: Default

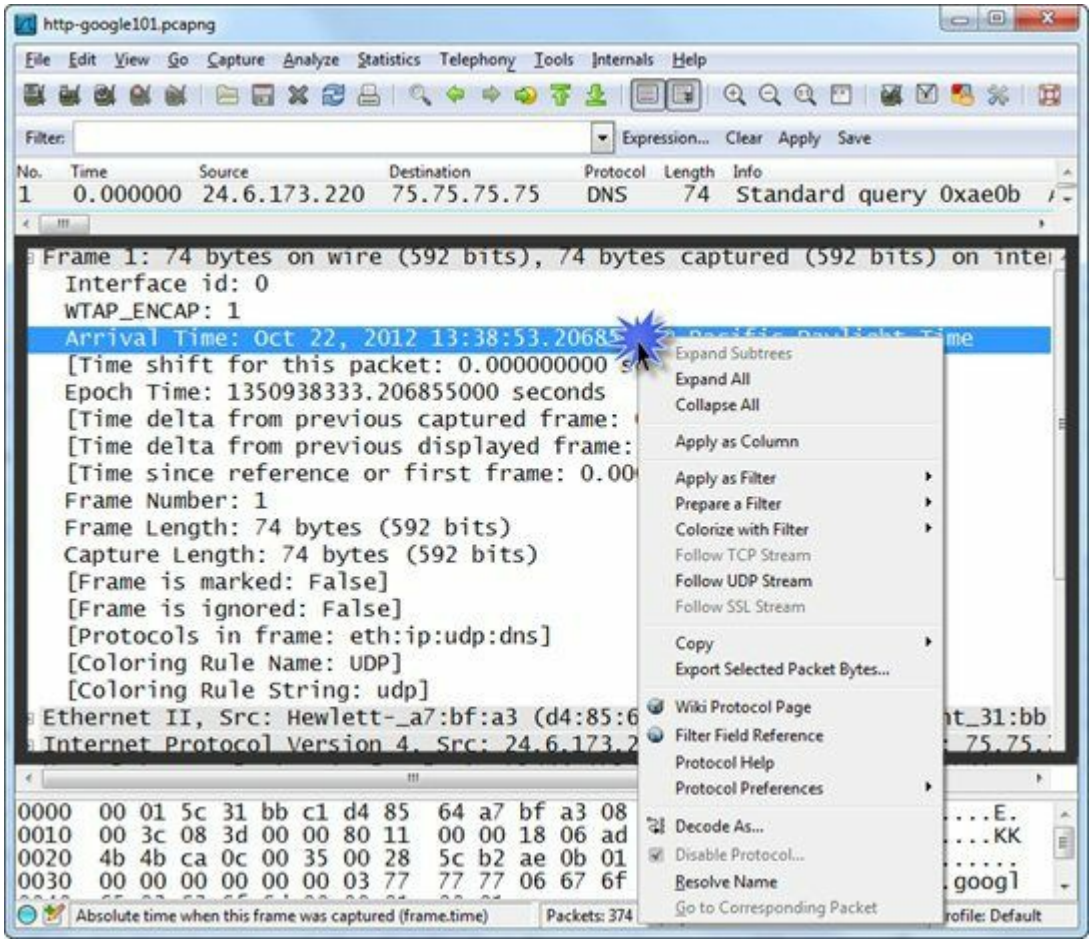
Figure 16. Right-click on any packet in the Packet List pane to see the available functions. [http–google101.pcapng]

Use Packet Coloring to Your Advantage

Wireshark contains 20 default coloring rules to help you identify the traffic types and spot network

problems faster. You can easily change these coloring rules and create additional coloring rules to

alert you to unusual traffic. We will work with coloring rules in *Identify Applied Coloring Rules*.


http-google101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
1 0.000000 24.6.173.220 75.75.75.75 DNS 74 Standard query 0xae0b
Frame 1: 74 bytes on wire (592 bits), 74 bytes captured (592 bits) on inte
Interface id: 0
WTAP_ENCAP: 1
Arrival Time: Oct 22, 2012 13:38:53.20685
[Time shift for this packet: 0.000000000
Epoch Time: 1350938333.206855000 seconds
[Time delta from previous captured frame:
[Time delta from previous displayed frame:
[Time since reference or first frame: 0.00
Frame Number: 1
Frame Length: 74 bytes (592 bits)
Capture Length: 74 bytes (592 bits)
[Frame is marked: False]
[Frame is ignored: False]
[Protocols in frame: eth:ip:udp:dns]
[Coloring Rule Name: UDP]
[Coloring Rule String: udp]
Ethernet II, Src: Hewlett-_a7:bf:a3 (d4:85:6
Internet Protocol Version 4, Src: 24.6.173.2
Expand Subtrees
Expand All
Collapse All
Apply as Column
Apply as Filter
Prepare a Filter
Colorize with Filter
Follow TCP Stream
Follow UDP Stream
Follow SSL Stream
Copy
Export Selected Packet Bytes...
Wiki Protocol Page
Filter Field Reference
Protocol Help
Protocol Preferences
Decode As...
Disable Protocol...
Resolve Name
Go to Corresponding Packet
0000 00 01 5c 31 bb c1 d4 85 64 a7 bf a3 08
0010 00 3c 08 3d 00 00 80 11 00 00 18 06 ad
0020 4b 4b ca 0c 00 35 00 28 5c b2 ae 0b 01
0030 00 00 00 00 00 00 03 77 77 77 06 67 6f
Absolute time when this frame was captured (frame.time)
Packets: 374

Dig Deeper in the Packet Details Pane

When you click on a packet in the Packet List pane, Wireshark shows the details for that packet in the

Packet Details pane (the middle pane). The Packet Details pane shows the power of Wireshark's

dissectors.

As mentioned earlier, the Frame section is not part of a packet as it travels through a network—

Wireshark adds the Frame section for additional information about the frame, such as when the frame

arrived, what coloring rule is applied to the frame, the frame number, and frame length, as seen in

Figure 17.

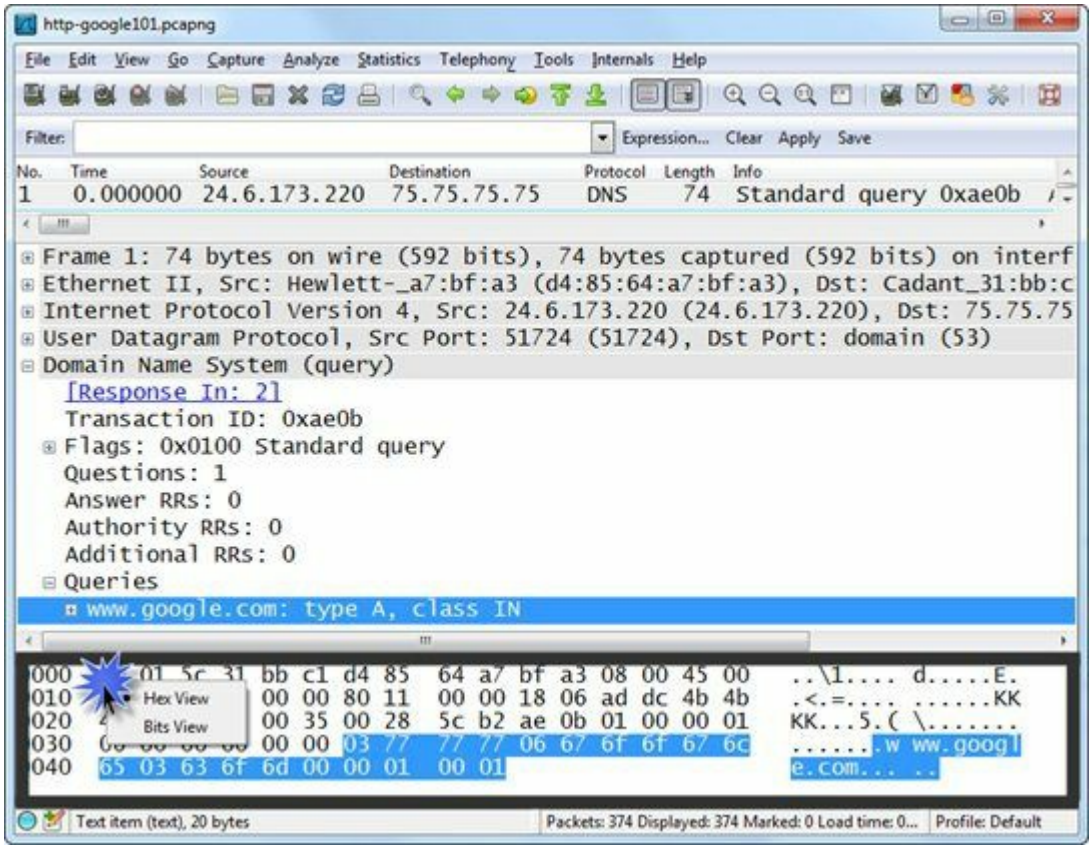
As you move through the Packet Details pane, click on the **+** indicators to expand sections of the

frames. Alternately you can use right-click to expand en entire frame (**Expand All**) or expand just one

collapsed section (**Expand Subtrees**).

Figure 17. The Frame section includes metadata such as arrival timestamp, frame number, and dissectors applied to the frame.

[http–google101.pcapng]


http-google101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
1 0.000000 24.6.173.220 75.75.75.75 DNS 74 Standard query 0xae0b
Frame 1: 74 bytes on wire (592 bits), 74 bytes captured (592 bits) on interf
Ethernet II, Src: Hewlett-_a7:bf:a3 (d4:85:64:a7:bf:a3), Dst: Cadant_31:bb:c
Internet Protocol Version 4, Src: 24.6.173.220 (24.6.173.220), Dst: 75.75.75
User Datagram Protocol, Src Port: 51724 (51724), Dst Port: domain (53)
Domain Name System (query)
[Response In: 2]
Transaction ID: 0xae0b
Flags: 0x0100 Standard query
Questions: 1
Answer RRs: 0
Authority RRs: 0
Additional RRs: 0
Queries
www.google.com: type A, class IN
Hex View
Bits View
Text item (text), 20 bytes
Packets: 374 Displayed: 374 Marked: 0 Load time: 0...
Profile: Default

Get Geeky in the Packet Bytes Pane

This is the "geek pane." The Packet Bytes pane shows the contents of the frame in hex and

ASCII formats, as shown in Figure 18. If the frame doesn't have any readable strings, the ASCII

portion will look like a bunch of junk. We may look at this pane when Wireshark sees "data" in a

frame.

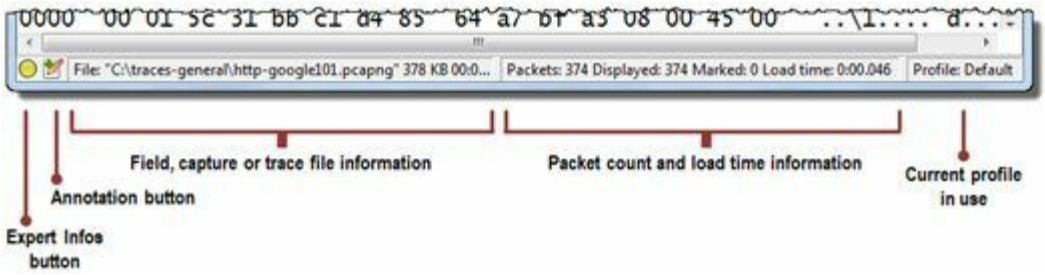
When you highlight a field in the Packet Details pane, Wireshark also highlights the location of that

field and the bytes contained in that field in the Packet Bytes pane.

If you don't want to see the Packet Bytes pane, select **View | Packet Bytes** to toggle it off. Perform the

same steps to turn it on again.

Figure 18. The packet bytes pane shows ASCII strings contained in the packet. [http–google101.pcapng]


0000 00 01 5c 31 bb 21 d4 85 64 a7 b1 a5 08 00 45 00 ..\1.!.. d.....
File: "C:\traces-general\http-google101.pcapng" 378 KB 00:0...
Packets: 374 Displayed: 374 Marked: 0 Load time: 0:00.046
Profile: Default
Field, capture or trace file information
Packet count and load time information
Current profile in use
Annotation button
Expert Infos button

Pay Attention to the Status Bar

The Status Bar consists of two buttons and three columns. These columns can be resized as necessary.

Figure 19. The Status Bar content changes depending on what you click on in the Packet List pane or Packet Details pane. [http-google101.pcapng]

Find Problems with the Expert Infos Button

The first button is the **Expert Infos** button. This button is colored to show you the highest level of

information contained in the Expert Infos window. The Expert Infos window can alert you to

numerous network concerns seen in the trace file as well as packet comments. We will work with the

Expert Infos window in *Use the Expert Infos Button on the Status Bar.*

Add Notes to a Trace File with the Annotation Button

The second button is the trace file **Annotation** button. Click this button to add, edit, or view a trace

file comment. This feature can only be used if the trace file has been saved in . *pcapng* format.

First Column: Get Field, Capture, or Trace File Information

The information shown in the first column (to the right of the **Annotation** button) changes depending

on what is highlighted in the panes above it or if you are running a live trace file. In Figure 19, we can

see the file name and size in this column. If you click on a field in the Packet Bytes pane, this column

displays the field name[10]. Click around inside the Packet Details pane to see the contents of this first column change.

Second Column: Get Packet Counts (Total and Displayed)

When you open a saved trace file, the second column indicates the total number of packets in the file,

the number of packets currently displayed (in case we applied a display filter), the number of marked

packets (packets we marked as "of interest"), and the amount of time required to load the trace file.

During a live capture, this column displays the number of packets captured, displayed, and marked.

In Figure 19, we can see that *http-google101.pcapng* contains 374 packets and we haven't filtered any

of them from view.

Third Column: Determine the Current Profile

The third column indicates your current profile. Figure 19 indicates that we are working in the *Default*

profile. Profiles are created so you can customize your Wireshark environment.

For more information on profiles, refer to *Customize Wireshark for Different Tasks (Profiles).*

There are two things you can do to improve efficiency using Wireshark.

First, try right-clicking on various packets, fields, and windows in Wireshark to determine if

right-click functionality is available. Many tasks are only available when you right-click. Other

can just be performed faster using the right-click method.

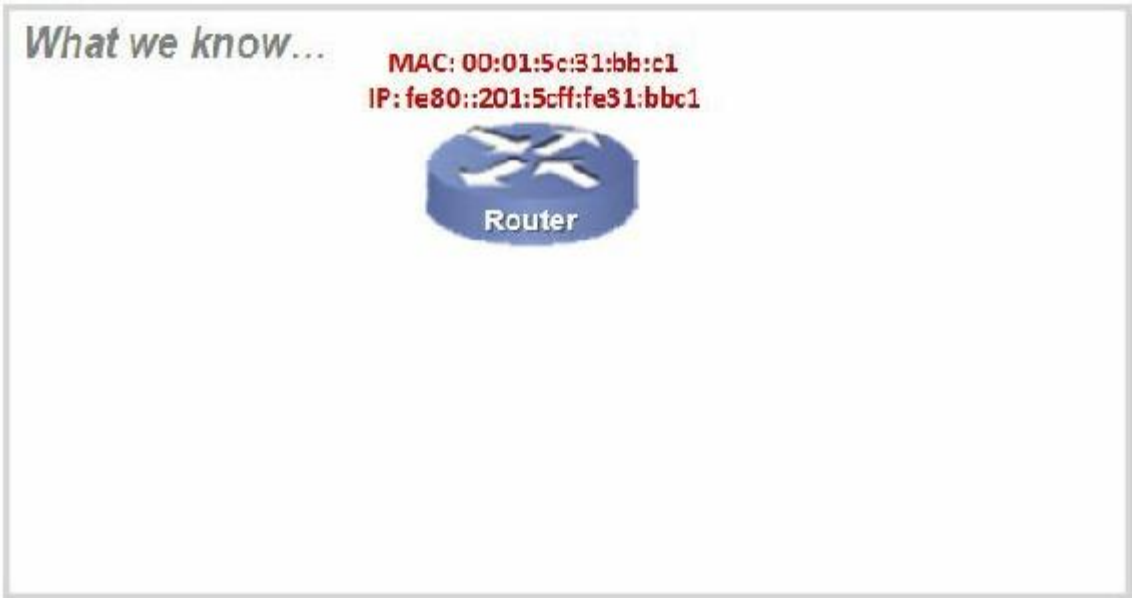
Second, get to know Wireshark's main toolbar and use that whenever possible.

Although Wireshark launches with the Start Page, once you leave the Start Page, you don't

return to it unless you close a trace file or restart Wireshark. Use the main toolbar and the

right-click method to work with trace files instead of returning to the Start Page.

Frame 1: 134 bytes on wire (1072 bits), 134 bytes captured (1072 bits) on interface 0
Ethernet II, Src: Cadant_31:bb:c1 (00:01:5c:31:bb:c1), Dst: IPv6mcast_00:00:00:01 (33:33:
Internet Protocol Version 6, Src: fe80::201:5cff:fe31:bbc1 (fe80::201:5cff:fe31:bbc1), Dst



Frame 2: 60 bytes on wire (480 bits), 60 bytes captured (480 bits) on interface 0
Ethernet II, Src: Cadant_31:bb:c1 (00:01:5c:31:bb:c1), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
Address Resolution Protocol (request)

Lab 1: Use Packets to Build a Picture of a Network

When you are analyzing traffic, try to get a feel for the network layout from what you can learn in the

packets. Who is sending the packets? Who are the targets? What are their MAC and IP addresses? If

multiple hosts talk through a device, it is likely a router. Switches are transparent, but you must

assume that clients go through switches to reach a router.

In this lab you will examine the MAC and IP addresses to build a picture of a portion of a network. In

addition, you will look at the **Protocol** column to determine what applications are running on various

hosts. Red text (visible in eBook versions only) indicates that we just learned this information from

the current frame.

Frame 1

Launch **Wireshark**, click the **File Open** button

on the main tool bar and double-click on

general101.pcapng to open this file.

Examine the Packet List pane. Frame 1 uses IPv6. Look in the Ethernet and IP headers for this frame

in the Packet Details pane (shown below). This appears to be an IPv6 multicast (note the *IPv6mcast*

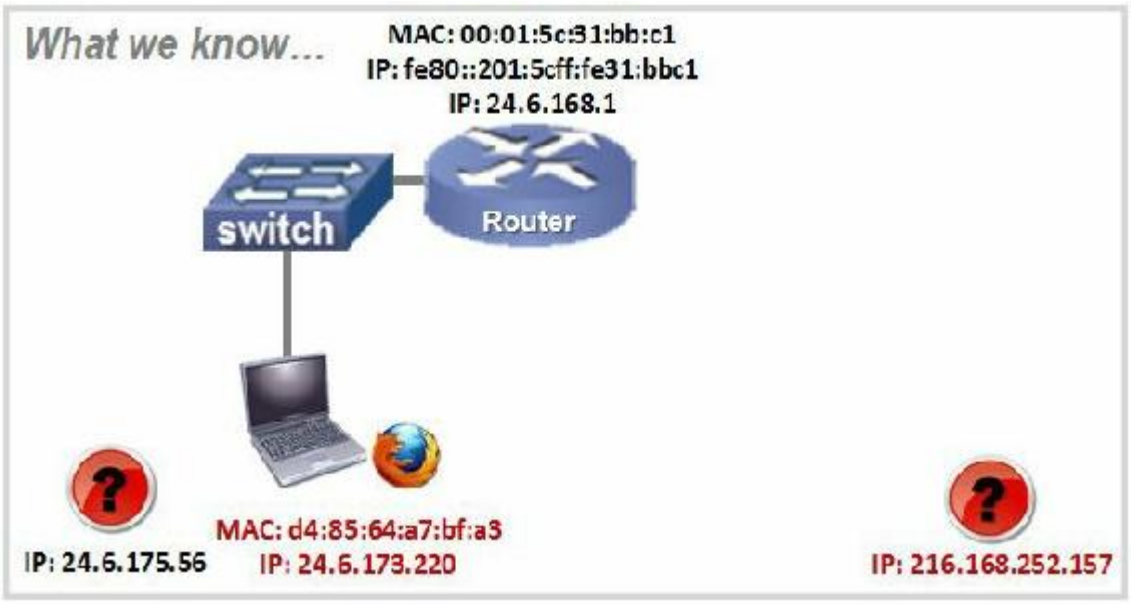
designation in the destination Ethernet address field).

Frame 2

Frame 2 is an ARP packet. Look inside the Ethernet header then inside the ARP portion of the packet.

This ARP request is sent to locate the MAC address of the Target IP Address.

Frame 3: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interface 0
Ethernet II, Src: Hewlett-_a7:bf:a3 (d4:85:64:a7:bf:a3), Dst: Cadant_31:bb:c1 (00:01:5c:3
Internet Protocol Version 4, Src: 24.6.173.220 (24.6.173.220), Dst: 216.168.252.157 (216.
Transmission Control Protocol, Src Port: 41865 (41865), Dst Port: http (80), Seq: 0, Len:



Frame 4: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interface 0
Ethernet II, Src: Cadant_31:bb:c1 (00:01:5c:31:bb:c1), Dst: Hewlett-_a7:bf:a3 (d4:85:64:a
Internet Protocol Version 4, Src: 216.168.252.157 (216.168.252.157), Dst: 24.6.173.220 (2
Transmission Control Protocol, Src Port: http (80), Dst Port: 41865 (41865), Seq: 0, Ack:

Frame 3

Frame 3 is a TCP handshake packet to the HTTP port. Again, look in the Ethernet header and IP

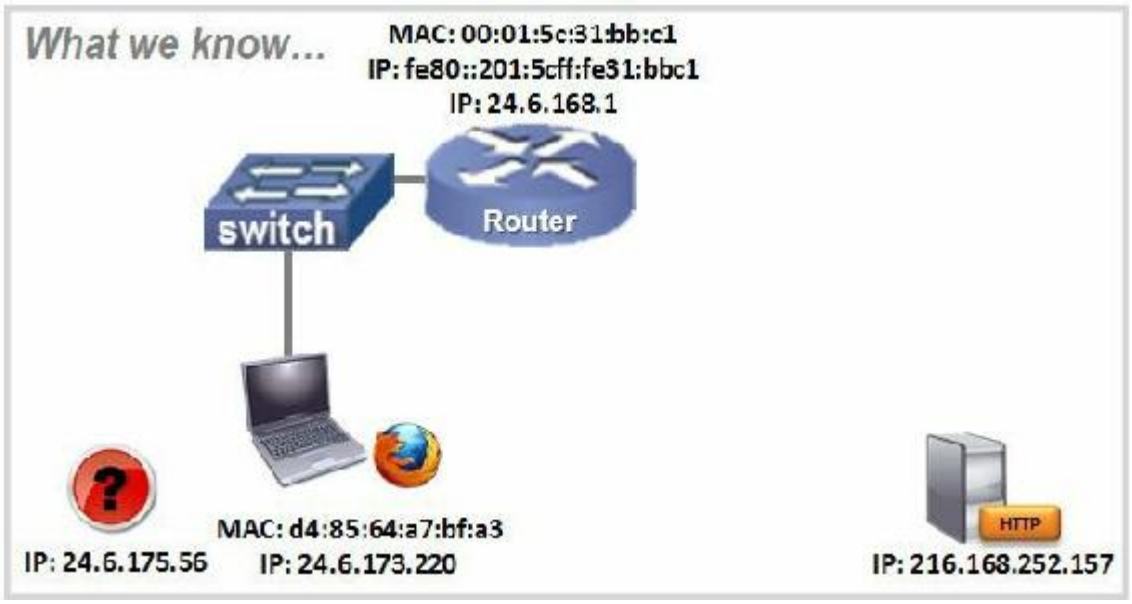
header to build your picture of the network. Since the target has not responded, we really can't say the

target is there. We will mark it with a question mark until we see it talk on the network.

Frame 4

Frame 4 is the reply to frame 3. We can now draw in the new HTTP server in our diagram. Look at the

source MAC address in frame 4. It comes from the router, not the source server.




```
Frame 6: 152 bytes on wire (1216 bits), 152 bytes captured (1216 bits) on interface 0
Ethernet II, Src: Hewlett-_a7:bf:a3 (d4:85:64:a7:bf:a3), Dst: Broadcast (ff:ff:ff:ff:ff:f
Internet Protocol Version 4, Src: 24.6.173.220 (24.6.173.220), Dst: 255.255.255.255 (255.
User Datagram Protocol, Src Port: db-lsp-disc (17500), Dst Port: db-lsp-disc (17500)
```

Remember that routers strip off the received MAC header and apply a new MAC header. The new

MAC header contains the address of the router's interface on this network as the new source MAC

address and the address of the destination device as the new destination MAC address. This is how a

router forwards a packet. On your local network, you may see traffic from many different IP addresses

come from the MAC address of the local router.

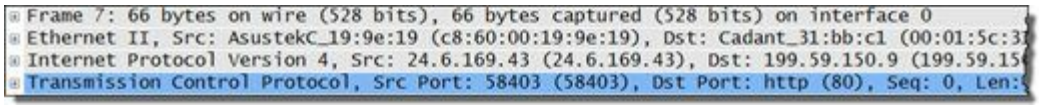
Frame 5 finishes the TCP 3-way handshake.

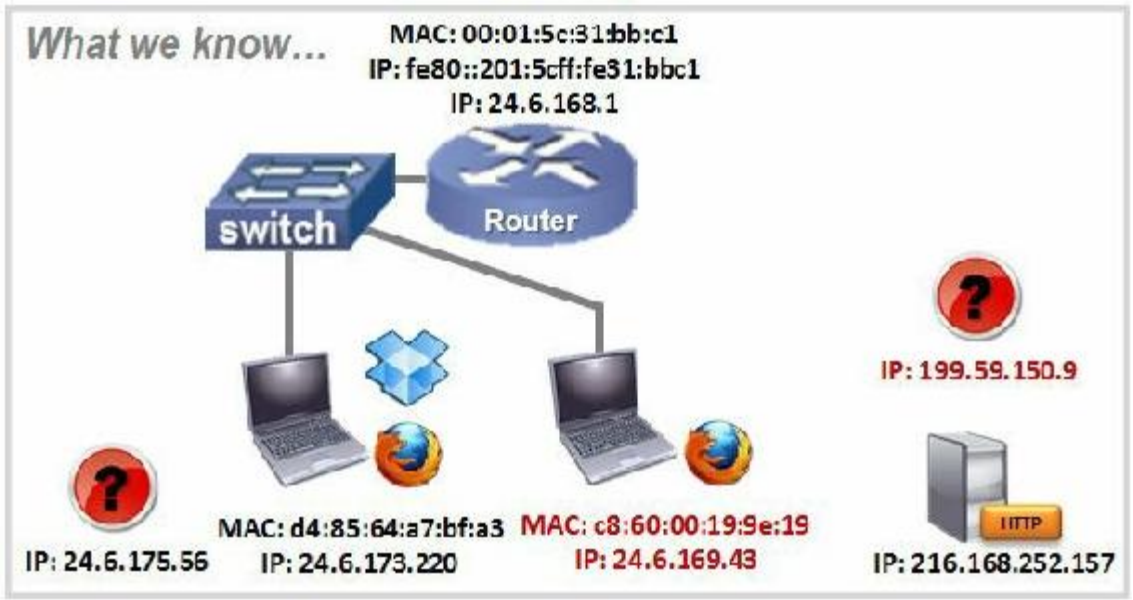
Frame 6

Frame 6 is a Dropbox LAN Sync Discovery Protocol (DB-LSB-DISC) packet from our client. This

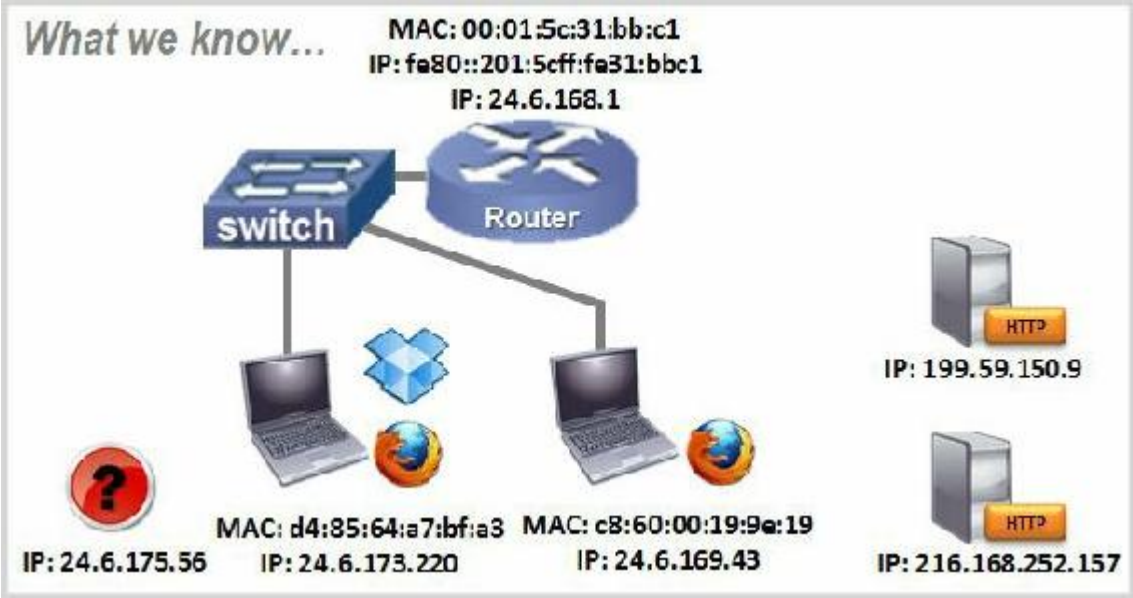
packet is sent to the broadcast address.

Frame 7


Frame 7: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interface 0
Ethernet II, Src: AsustekC_19:9e:19 (c8:60:00:19:9e:19), Dst: Cadant_31:bb:c1 (00:01:5c:31
Internet Protocol Version 4, Src: 24.6.169.43 (24.6.169.43), Dst: 199.59.150.9 (199.59.15
Transmission Control Protocol, Src Port: 58403 (58403), Dst Port: http (80), Seq: 0, Len:



Frame 8: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interface 0
Ethernet II, Src: Cadant_31:bb:c1 (00:01:5c:31:bb:c1), Dst: AsustekC_19:9e:19 (c8:60:00:1
Internet Protocol Version 4, Src: 199.59.150.9 (199.59.150.9), Dst: 24.6.169.43 (24.6.169
Transmission Control Protocol, Src Port: http (80), Dst Port: 58403 (58403), Seq: 0, Ack:



Frame 7 is another TCP handshake packet, but we have a new source and destination. We can now

draw in a new source MAC and IP address and a new destination IP address. We must wait for the

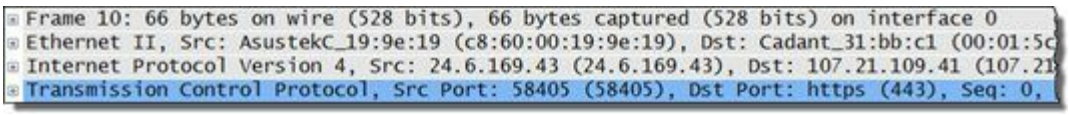
target to send a packet before we say it is definitely there.

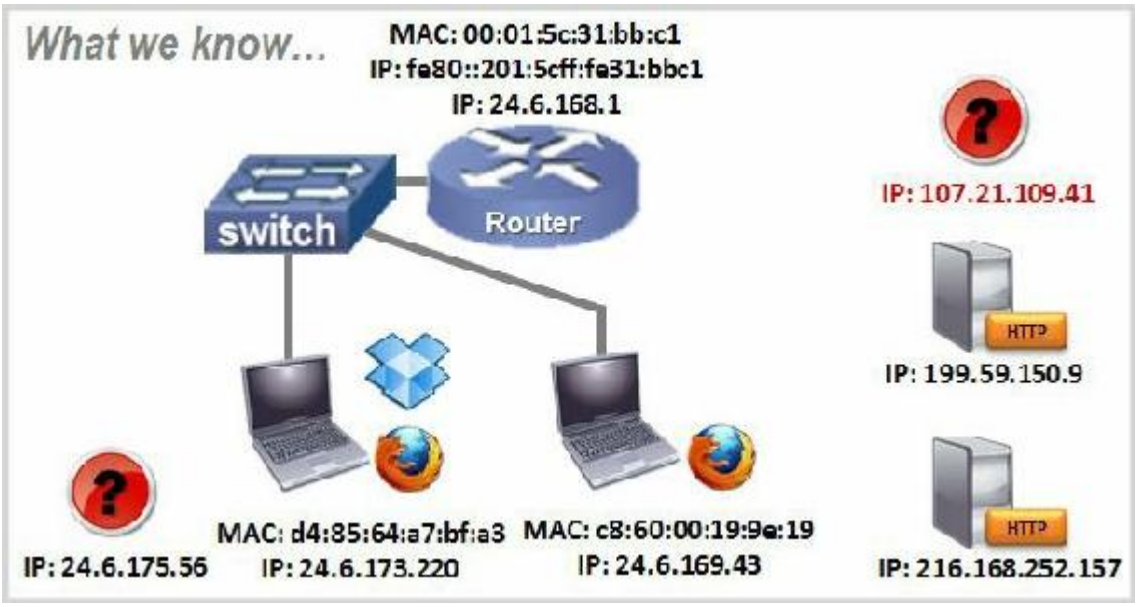
Frame 8

Frame 8 is the answer from the HTTP server (199.59.150.9). We now know that this server is talking

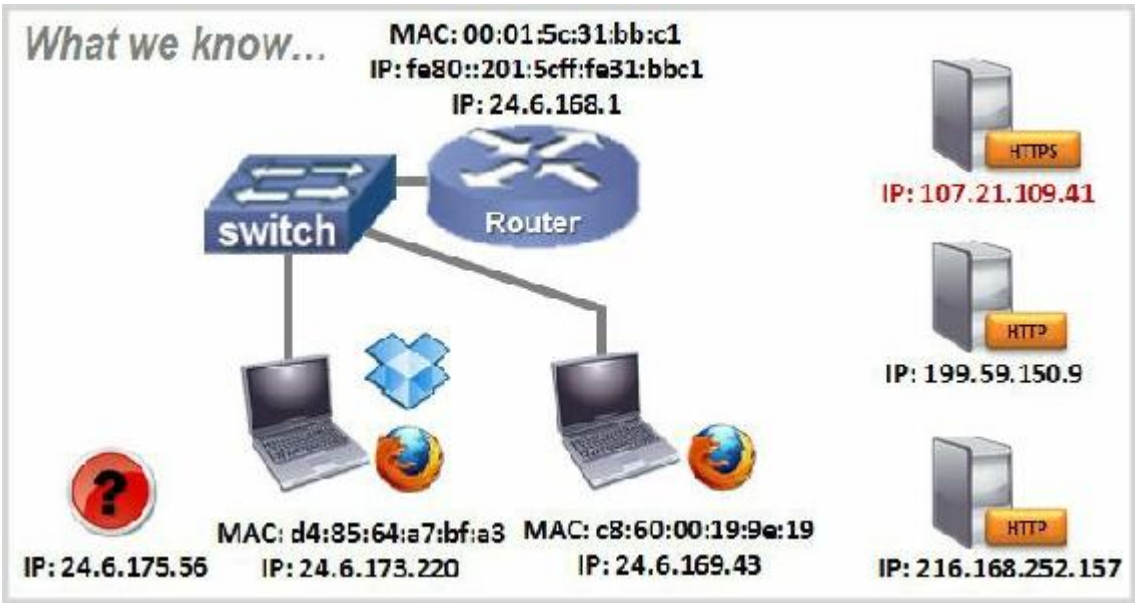
on the wire. Frame 9 is the final piece of the TCP handshake.

Frame 10


Frame 10: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interface 0
Ethernet II, Src: AsustekC_19:9e:19 (c8:60:00:19:9e:19), Dst: Cadant_31:bb:c1 (00:01:5c
Internet Protocol Version 4, Src: 24.6.169.43 (24.6.169.43), Dst: 107.21.109.41 (107.21
Transmission Control Protocol, Src Port: 58405 (58405), Dst Port: https (443), Seq: 0,



Frame 11: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interface 0
Ethernet II, Src: Cadant_31:bb:c1 (00:01:5c:31:bb:c1), Dst: AsustekC_19:9e:19 (c8:60:00
Internet Protocol Version 4, Src: 107.21.109.41 (107.21.109.41), Dst: 24.6.169.43 (24.6
Transmission Control Protocol, Src Port: https (443), Dst Port: 58405 (58405), Seq: 0,



Frame 10 indicates that the other local host is trying to connect to another server. This time the target

is port 443, the HTTPS port.

Frame 11

Frame 11 is a response from the target. We can now assume the target is running. Frame 12 finishes

the TCP handshake and our drawing of the network we discovered just by looking at these first few

packets in the trace file.

As you can see, lots of different conversations are occurring simultaneously. We can build a picture of

the network based on the packets we see. Building an image of a network based on traffic is a common

task used in analysis.

0.9. Analyze Typical Network Traffic

What is "typical network traffic?" That is a loaded question. Every network is different. They may

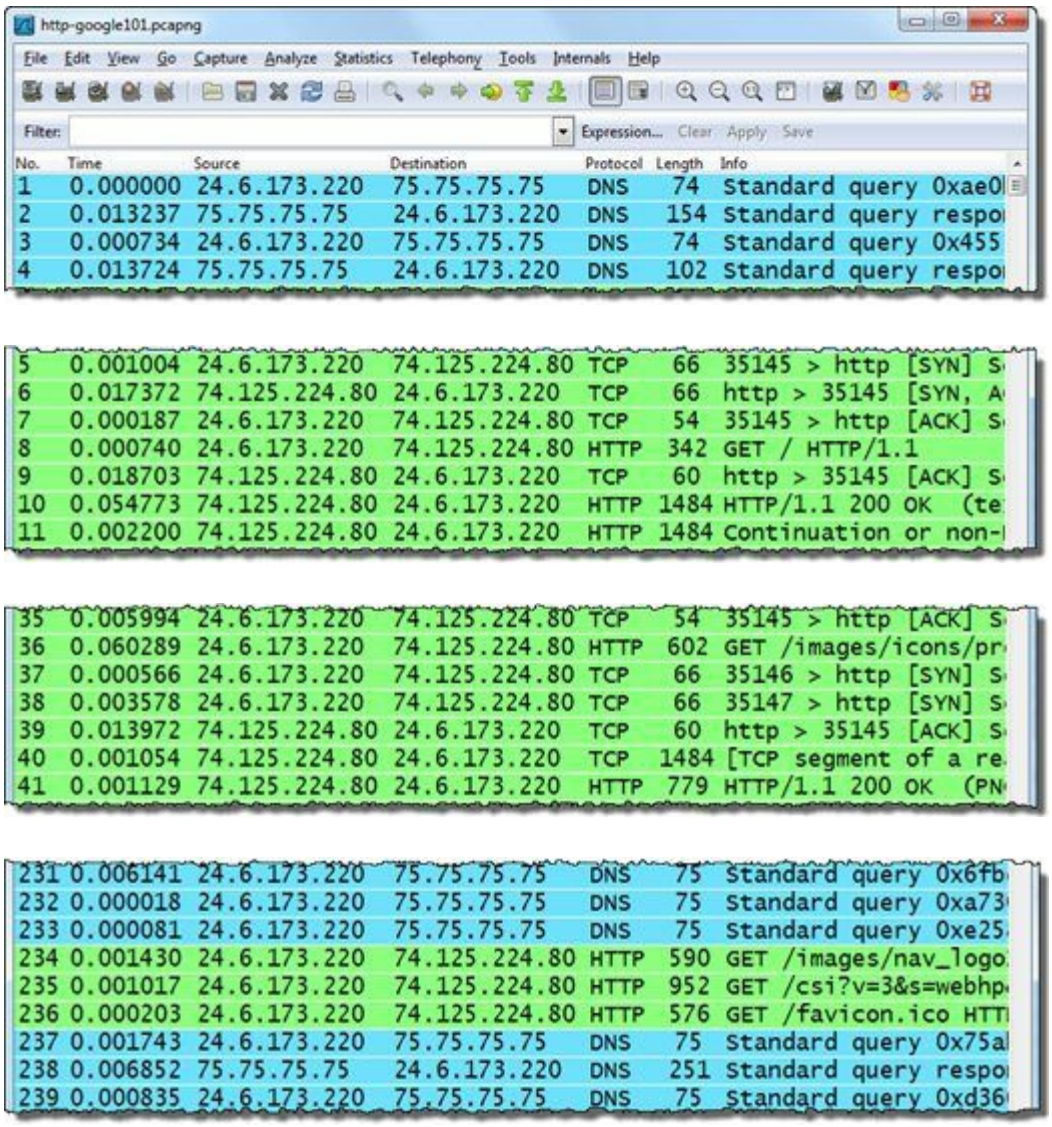
support different applications and have different network designs. There are, however, some common

packets that you'll see during most login procedures and web browsing sessions. There are also some

basic TCP/IP resolutions that take place and can usually be seen on the network.

Let's just take a look at what you might see in a typical web browsing process and discuss the types of

background traffic that can be seen as well.



Analyze Web Browsing Traffic

Open ***http-google101.pcapng***[11] and follow along as we look at the traffic generated when someone visits *www.google.com*[12].

In a typical web browsing session, your trace file will probably include a DNS request to resolve a

host name to an IP address (referred to as an "A" record) [frame 1]. Hopefully a DNS reply will be

sent back with at least one IP address associated with that host name [frame 2].

If the client supports both IPv4 and IPv6, you'll see a request to find an IPv6 address (referred to as an

"AAAA" record) next [frame 3]. The DNS server will respond with either an IPv6 address or

miscellaneous information [frame 4].

Next we see the TCP three-way handshake between the client and the web server [frames 5, 6, and 7]

and then the client's request to GET the main page ("/") [frame 8]. The server acknowledges receipt of the request [frame 9] and sends the OK response [frame 10][13]. Now the server begins sending the main page to the client [frame 11].

Periodically, the client requests another element of the *www.google.com* page [frame 36] from the

same server.

In addition, when there is a link on *www.google.com* to another web site, the client will make a DNS

query for that next site (as in frames 231, 232, 233, for example). These DNS queries are triggered

when the JavaScript menu bar is loaded.

You can likely see the relationship between the DNS queries and the menu, shown below.

Continue to look through the trace file to get a feel for the traffic that crosses the network when

someone opens the main Google page.

Analyze Sample Background Traffic

You will surely see some "background traffic" on your network. Background traffic is generated when

automated processes run—no user interaction is required. Background traffic can be seen when Java

looks for updates, your virus detection tool looks for updates, Dropbox checks in, IPv6 tries to

discover IPv6 routers, and more.

Become familiar with your background traffic so you can recognize it when you are

troubleshooting problems. You don't want to waste time troubleshooting a background process that

has nothing to do with the problem at hand.

Open ***mybackground101.pcapng*** to look at the background traffic seen from one of our lab machines.

Here is a breakdown of the background traffic on our lab host.

Starting at frame 1, we see traffic to/from 67.217.65.244 (use an IP address lookup site such as

DomainTools.com to check the address and you'll see this is Citrix) —sure enough, this lab host is

running GoToAssist, GoToMeeting, and GoToMyPC applets which are all owned by Citrix.

In frame 25, we see ICMPv6 Neighbor Notifications generated by the IPv6 stack, which is

enabled on the lab host (it is a Windows 7 host).

In frame 27, we see a Local Master Announcement. If we expand the Packet Details pane, we

learn that the lab host is called VID02.

Starting at frame 28, we can see some DNS queries for *javadl-esd-secure.oracle.com*. It looks

like our host is updating Java from an Akamai host (we expanded the Packet Details pane to look

inside the DNS response for that tidbit).

Frame 33 tells us that there is an IPv6 router on the network—we see ICMPv6

Router Advertisement packets.

Frame 83 is a DHCP ACK broadcast onto the network—it indicates the domain is *comcast.net*—

yup, that's the ISP serving the lab network.

Frame 95 is an SNMP get-request to 192. 168.1.105—we don't see an answer anywhere in the

trace file. This is an interesting one. It seems the lab host is configured to look for a network

printer by that address, but no such printer exists. (Guess we need to clean off that machine a bit,

eh?).

Starting at frame 96, we learn that our lab host is also running Dropbox—we see some Dropbox

LAN Sync Discovery Protocol traffic in there.

Starting at frame 118, we learn the lab host also runs Memeo for backup—we see some HTTP

traffic going to *www.memeo.info* (frame 121 in the expanded HTTP part of the Packet Details)

and *api.memeo.info* (frame 134 in the expanded HTTP part of the Packet Details).

This is what a background traffic analysis session feels like—looking through the traffic to define

what is "normal." Once we know what is normal, we can look past that to detect what is abnormal.

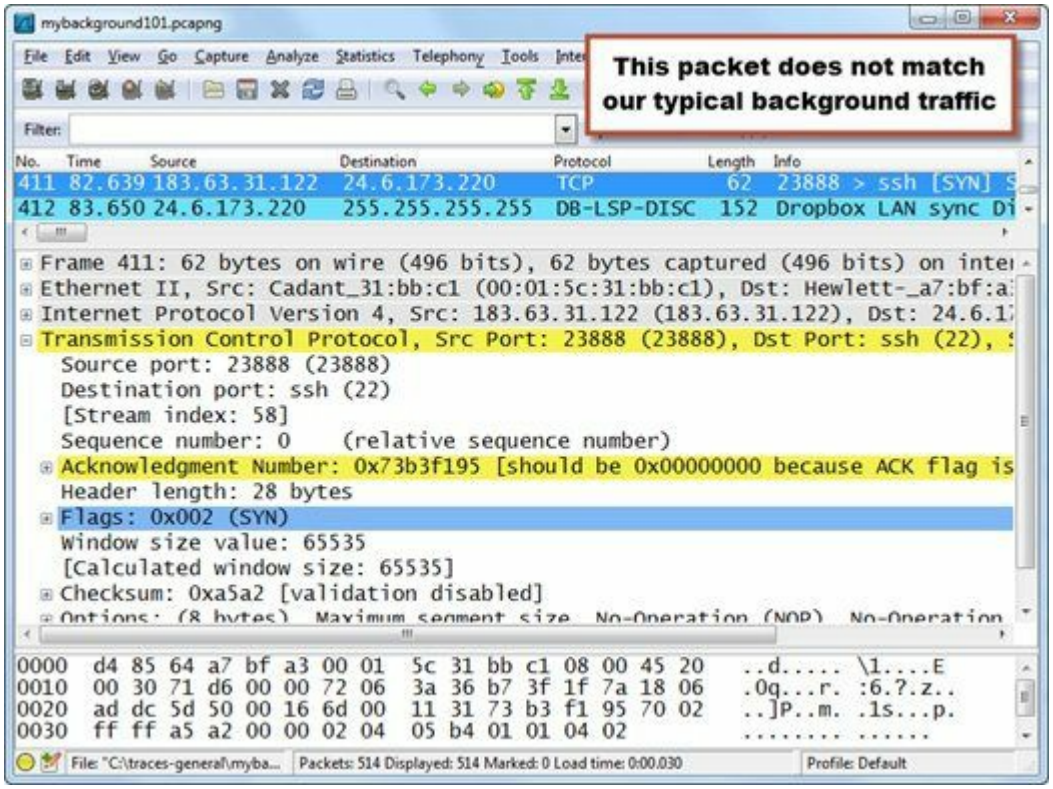
For example, frame 411 doesn't match the regular traffic we expect to see in a background trace file.

In Figure 20, we see an incoming TCP connection attempt (SYN) which is not expected—this is a

client, not a server. In the Packet Details pane, we see the packet is sent to the Secure Shell port (22)

—that's a bit of a concern. We also see that Wireshark indicates that something is wrong with the TCP

header—there is an illegal value in the Acknowledgment Number field.


mybackground101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools
This packet does not match our typical background traffic
Filter:
No. Time Source Destination Protocol Length Info
411 82.639 183.63.31.122 24.6.173.220 TCP 62 23888 > ssh [SYN]
412 83.650 24.6.173.220 255.255.255.255 DB-LSP-DISC 152 Dropbox LAN sync Di
Frame 411: 62 bytes on wire (496 bits), 62 bytes captured (496 bits) on inte
Ethernet II, Src: Cadant_31:bb:c1 (00:01:5c:31:bb:c1), Dst: Hewlett-_a7:bf:a
Internet Protocol Version 4, Src: 183.63.31.122 (183.63.31.122), Dst: 24.6.1
Transmission Control Protocol, Src Port: 23888 (23888), Dst Port: ssh (22),
Source port: 23888 (23888)
Destination port: ssh (22)
[Stream index: 58]
Sequence number: 0 (relative sequence number)
Acknowledgment Number: 0x73b3f195 [should be 0x00000000 because ACK flag is
Header length: 28 bytes
Flags: 0x002 (SYN)
Window size value: 65535
[Calculated window size: 65535]
Checksum: 0xa5a2 [validation disabled]
0000 d4 85 64 a7 bf a3 00 01 5c 31 bb c1 08 00 45 20 ..d..... \1....E
0010 00 30 71 d6 00 00 72 06 3a 36 b7 3f 1f 7a 18 06 .0q...r. :6.?.z..
0020 ad dc 5d 50 00 16 6d 00 11 31 73 b3 f1 95 70 02 ..]P..m. .1s...p.
0030 ff ff a5 a2 00 00 02 04 05 b4 01 01 04 02 ....
Packets: 514 Displayed: 514 Marked: 0 Load time: 0:00.030
Profile: Default

TIP

Figure 20. Finding the needle in the haystack isn't difficult if you know the haystack well and can just move it aside.

[mybackground101.pcapng]

So who is this 183.63.31.122 host?

Doing a bit of research on the source IP address, we gather the following information:

inetnum: 183.0.0.0-183.63.255.255

netname: CHINANET Guangdong province network

descr: Data Communication Division

descr: China Telecom

country: CN

status: ALLOCATED PORTABLE

remarks: service provider

And, of course, this address popped up at the Internet Storm Center[14] with over 293,000 reports of folks being scanned on port 22 from this host.

Networks can be pretty noisy with various background processes running, but if you can spend some

time getting familiar with the "normal" ones, it shouldn't take you long to find the real stinkers.

In this book you will learn a lot about filtering. Once you learn what is "normal," consider

building a filter to remove this normal traffic from view. What is left after filtering out the good

traffic may be one or more shiny needles.

Lab 2: Capture and Classify Your Own Background Traffic

Take a moment and capture your own background as we did in this section. When you complete your

capture, perform some research on the resulting trace file to see if you can characterize all the traffic

to/from your machine when you are not touching the keyboard.

Step 1: Close all applications except for Wireshark and any normal background applications that run

on your machine.

Step 2: Click the **Capture Interfaces**

button on the main toolbar.

Step 3: Select the checkbox in front of the interface that sees active traffic. If you don't see any

increases in the packet counts, be patient or toggle out to the command prompt to ping another host.

You might recognize your active interface or only have one interface to select from.

Step 4: Click **Start**. Let the capture run for at least five minutes (longer if you can wait).

Step 5: Click the **Stop Capture** button

on the main toolbar.

Spend some time going through the trace file to identify the applications that run in the background on

your machine. Focus on the **Protocol** column and the **Info** column.

If you don't recognize the application, perform some research on the IP addresses that your system

communicates with. Most likely you will also see broadcast or multicast traffic from other hosts on

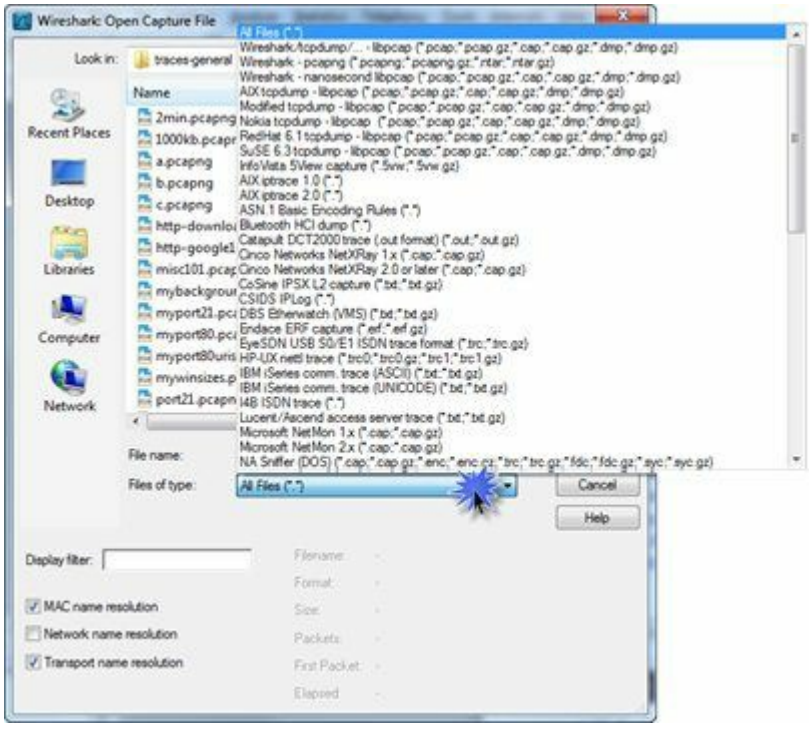
your network.

Step 5: To save this file, click the **Save** button on the main toolbar, navigate to the target directory, and name your file ***background1.pcapng***.

Recognizing your own background traffic will help you remove this from consideration when looking

for unusual communications. Consider saving trace files of your "normal" traffic to refer to when

troubleshooting.



TIP

0.10. Open Trace Files Captured with Other

Tools

Although Wireshark is considered the de facto standard in packet capture and analysis tools, there are

numerous other tools available. It is important to know which tools can interoperate with Wireshark.

When someone hands you a trace file, you can use **File | Open** to examine the traffic in Wireshark.

Wireshark uses its Wiretap Library to convert the file into a format that Wireshark can display. For

example, if you receive a trace file captured using Sun Snoop (with the .snoop file extension),

Wireshark uses the Wiretap Library to perform the input/output function—handing the frames up to

Wireshark for analysis.

Select **File | Open** (or the **File Open** button on the main toolbar) and click on the arrow next to the **Files of Type** area. Wireshark lists all the file types recognized, as shown in Figure 21.

*Figure 21. Click the arrow next to **Files of type** to see all the trace file formats that Wireshark recognizes.*

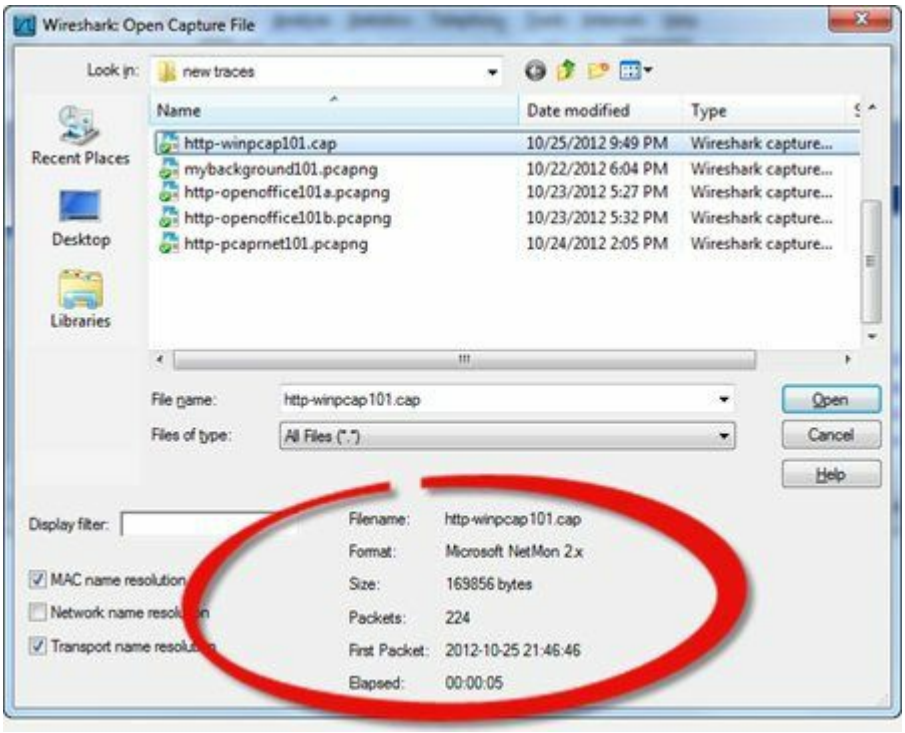
If someone sends you a trace file and Wireshark doesn't recognize the format, first just

change the file extension to .pcap (the old default trace file format) and try to open it in

Wireshark. If that doesn't work, ask them what #$&@! tool they used to capture the traffic!*

Wireshark understands so many formats. It is very unusual to receive a trace file in an

unrecognized format.



Lab 3: Open a Network Monitor .cap File

In this lab you will use Wireshark's Wiretap Library to open a file captured with Microsoft's Network

Monitor.

Step 1: Click the **File Open** button

on the main toolbar.

Step 2: Navigate to your trace file directory and click on ***http-winpcap101.cap***. Wireshark looks inside the trace file to identify what tool was used to capture the traffic, as shown below. Although

this file was captured with Microsoft's Network Monitor (NetMon) v3.4, Wireshark marks it as

NetMon v2 because that is the format v3.4 saves in.

Step 3: Click **Open**. Once the file is open, select **File | Save As** and click the drop down menu arrow next to Files of Type. Select **Wireshark – pcapng (*pcapng;*.pcapng.gz;*.ntar;*.ntar.gz)** and name

the file ***http–winpcap101.pcapng***.

Wireshark can recognize and open trace files created with most other industry tools. Once open, the

fact that this trace file was captured with Network Monitor is transparent to you.

Chapter 0 Challenge

Open *challenge101-0.pcapng* and use the techniques covered in this chapter to answer these Challenge

questions. The answer key is located in Appendix A.

We will focus on what you can learn about communications based on the main Wireshark view.

Question 0-1.

How many packets are in this trace file?

Question 0-2.

What IP hosts are making a TCP connection in frames 1, 2, and 3?

Question 0-3.

What HTTP command is sent in frame 4?

Question 0-4.

What is the length of the largest frame in this trace file?

Question 0-5.

What protocols are seen in the **Protocol** column?

Question 0-6.

What responses are sent by the HTTP server?

Question 0-7.

Is there any IPv6 traffic in this trace file?

Chapter 1 Skills: Customize Wireshark

Views and Settings

"To me, analyzing networks is a bit like practicing a sport like skiing or golf. When you start, it's

tough and a bit frustrating, but practice and persistence will make you accomplish amazing things.

Remember that becoming a master is a matter of improving your skills, but also of getting the best

from your tools. Don't get discouraged if things seem a bit overwhelming at the beginning—you'll

improve fast and it's going to be a ton of fun!"

Loris Degioanni

Creator of WinPcap and Cascade Pilot®

Riverbed Technology
WinPcap
4
5
IPv4 ✓ IPv6 ?
WIRESHARK
the world's foremost network protocol analyzer
1 Wireshark
2 Get Help
3 Develop
Search
6
Download Wireshark
Get Started Now
7
Learn Wireshark
Resources and Documentation
8
Enhance Wireshark
Riverbed Technology
News and Events 9
Laura's Book Updated!
Laura Chappel has released the second edition of Wireshark Network Analysis, the official Wireshark Certified Network Analyst study guide. This edition covers new features in Wireshark 1.8 including pcap-ng and annotations. A Kindle edition is now available!
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Wireshark Blog 10
Wireshark Tutorial Series. Tips and tricks used by insiders and veterans
Oct 17 | By hansangb
Sharkfest '12 Recap
Jun 29 | By Gerald Combs
Wireshark and Pcap-ng
Mar 6 | By Gerald Combs
Sniff free or die Blog »
Videos and Presentations
Introduction To Wireshark
Enhance Wireshark
Troubleshoot your Network
Free 30 day trial
Save hours on network and application issue diagnoses
Monitor physical and virtual environments
GUI packet capture and analysis
Fully integrated with Wireshark
Try Cascade Shark VE & Cascade Pilot Free for 30 days
802.11 Packet Capture
WLAN packet capture and transmission
Full 802.11 a/b/g/n support
View management, control and data

Quick Reference: Overview of wireshark.org

1. Wireshark—About Wireshark, author list, feature set, awards

2. Get Help—Q&A Forum, FAQ, docs, mailing lists, tools, Wiki page, Bug Tracker

3. Develop—Developers' Guide, browse the code, latest development builds

4. Link to WinPcap site

5. Indication of the protocol used to access the site (IPv4 or IPv6)

6. Main link to the download page (auto-detects your incoming OS)

7. Link to training, docs, videos, mirror instructions, export regulations

8. Link to Riverbed, owner of the Wireshark trademark

9. General news and events list

10. Gerald Combs' Wireshark blog

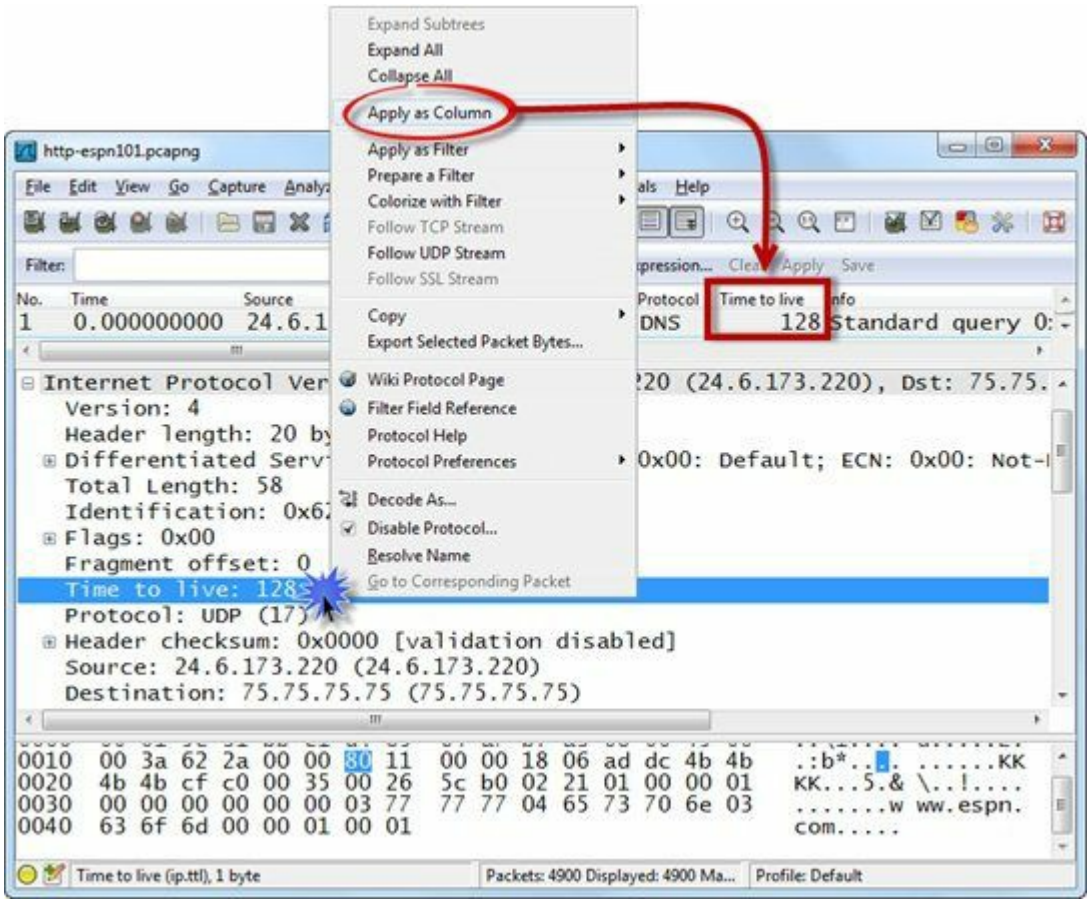
1.1. Add Columns to the Packet List Pane

Wireshark contains a default set of columns that provide basic information. If you are focused on a

particular issue, however, adding columns can help you quickly detect behavior patterns.

There are two ways to add columns to the Packet List pane—the easy way and the hard way. You

should know both methods because sometimes columns can't be created using the easier method.



Right-Click | Apply as Column (the "easy way")

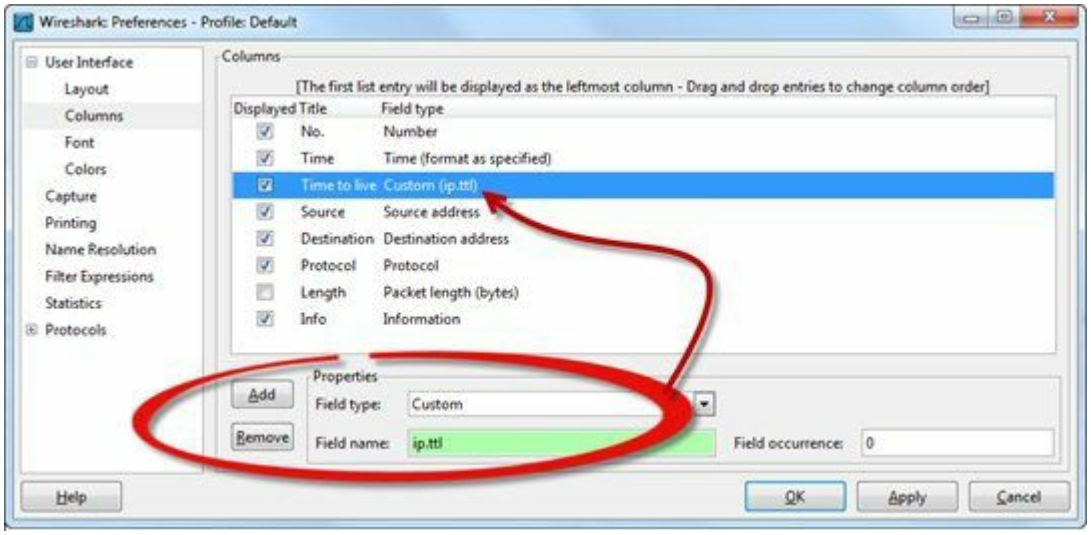
The Packet Details pane displays the fields and values contained in the frames. Open a trace file and

right-click on the Internet Protocol section in the Packet Details pane. Select **Expand All** to see all the fields in the entire frame.

To add any field as a column, right-click on the field and select **Apply as Column,** as shown in Figure

22. In this example, we quickly created an IP **Time to Live** (TTL) column.

*Figure 22. Right-click on any frame field and select **Apply as Column**. [http-espn101.pcapng]*



Edit | Preferences | Columns (the "hard way")

If you don't have a packet that contains the desired field for the right-click method, you'll need to use

the hard way to build columns. Select **Edit | Preferences | Columns** to see the existing columns,

change the order of the columns, and add columns. Click on the arrow to the right of the **Field type**

area to see a list of available predefined columns.

If the column you want to create isn't listed, you must click the **Add** button and select **Custom** as the field type, as shown in Figure 23. Finally, you must enter the field name (**ip.ttl**) and which occurrence

of the field you want displayed in the column (if the field occurs more than once in a packet). Leave

the occurrence number at 0 to view all occurrences of a field. Click on the **Title** column entry to type

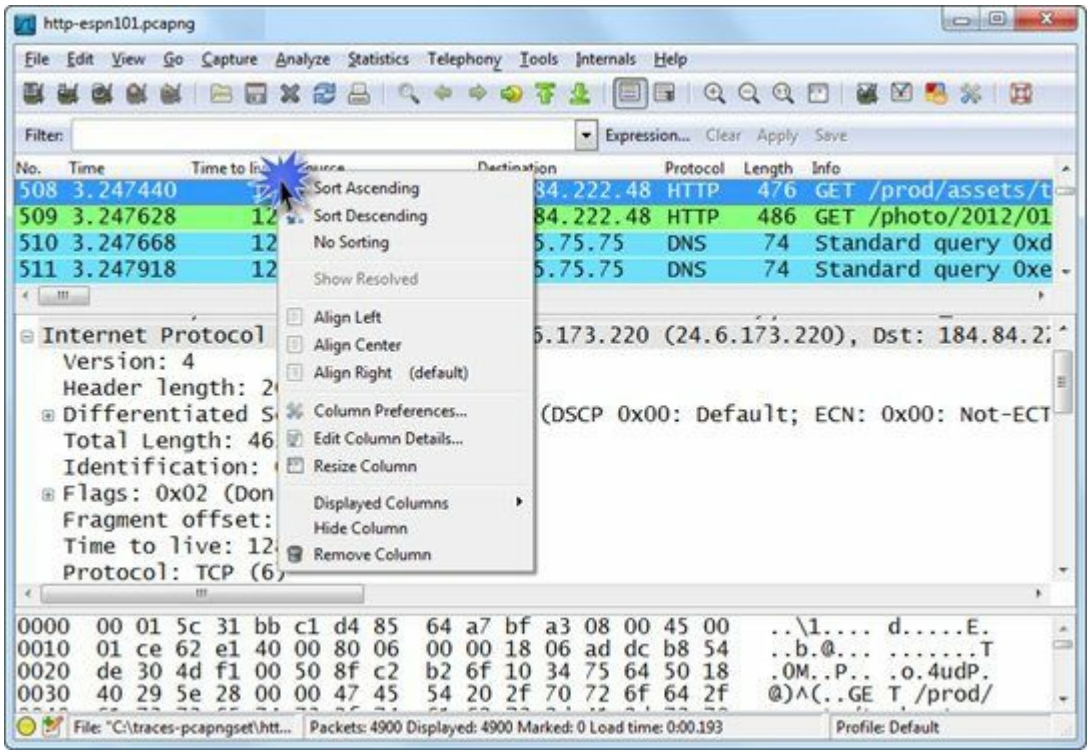
in the new column heading.

It is much easier to just right-click on an IP TTL field and select **Apply as Column**.

*Figure 23. You can add, edit, and rearrange columns in the Preferences window. We clicked and dragged the **Time to Live***

*column to place it above the **Source** column.*

TIP


http-espn101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Protocol Length Info
508 3.247440 HTTP 476 GET /prod/assets/t
509 3.247628 HTTP 486 GET /photo/2012/01
510 3.247668 DNS 74 Standard query 0xd
511 3.247918 DNS 74 Standard query 0xe
Sort Ascending
Sort Descending
No Sorting
Show Resolved
Align Left
Align Center
Align Right (default)
Column Preferences...
Edit Column Details...
Resize Column
Displayed Columns
Hide Column
Remove Column
Internet Protocol
Version: 4
Header length:
Differentiated S
Total Length: 46
Identification:
Flags: 0x02 (Don
Fragment offset:
Time to live: 12
Protocol: TCP (6)
(DSCP 0x00: Default; ECN: 0x00: Not-ECT
0000 00 01 5c 31 bb c1 d4 85 64 a7 bf a3 08 00 45 00
0010 01 ce 62 e1 40 00 80 06 00 00 18 06 ad dc b8 54
0020 de 30 4d f1 00 50 8f c2 b2 6f 10 34 75 64 50 18
0030 40 29 5e 28 00 00 47 45 54 20 2f 70 72 6f 64 2f
Packets: 4900 Displayed: 4900 Marked: 0 Load time: 0:00.193
Profile: Default

Hide, Remove, Rearrange, Realign, and Edit Columns

You can use the Preferences window to perform functions on your columns, but this is not the fastest

way to work with columns. Close the Preferences window and right-click on a column heading in the

Packet List pane to specify alignment, edit the column title, temporarily hide (or display) a column, or

even delete a column. Click and drag windows left or right to reorder them.

For example, in Figure 24, we are working with *http-espn101.pcapng*. We right-clicked on our new

Time to live column to view the available column options. If we do not want to use this column again,

we can select **Remove Column**.

Adding columns to the Packet List pane can save a lot of time when you're comparing traffic

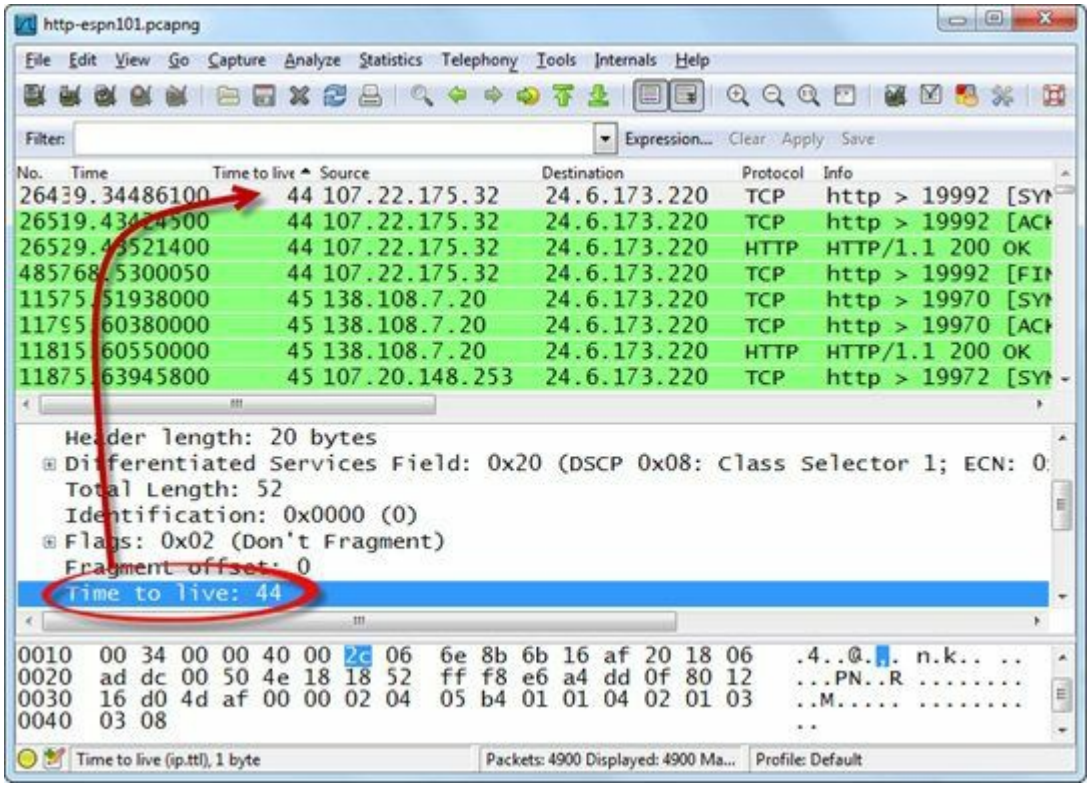
characteristics. Be careful of going column-crazy, however. Wireshark will process all

displayed and hidden columns when it opens a trace file or applies a display filter. If you

create and hide 30 different columns, Wireshark is going to be much slower than if you just

remove and recreate the columns as you need them.

Figure 24. Right-click on a column heading to perform basic column functions. [http–espn101.pcapng]


http-espn101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Time to live Source Destination Protocol Info
26439.34486100 44 107.22.175.32 24.6.173.220 TCP http > 19992 [SYN
26519.43424500 44 107.22.175.32 24.6.173.220 TCP http > 19992 [ACK
26529.43521400 44 107.22.175.32 24.6.173.220 HTTP HTTP/1.1 200 OK
485768.5300050 44 107.22.175.32 24.6.173.220 TCP http > 19992 [FIN
11575.51938000 45 138.108.7.20 24.6.173.220 TCP http > 19970 [SYN
11795.60380000 45 138.108.7.20 24.6.173.220 TCP http > 19970 [ACK
11815.60550000 45 138.108.7.20 24.6.173.220 HTTP HTTP/1.1 200 OK
11875.63945800 45 107.20.148.253 24.6.173.220 TCP http > 19972 [SYN
Header length: 20 bytes
Differentiated Services Field: 0x20 (DSCP 0x08: Class Selector 1; ECN: 0
Total Length: 52
Identification: 0x0000 (0)
Flags: 0x02 (Don't Fragment)
Fragment offset: 0
Time to live: 44
0010 00 34 00 00 40 00 2c 06 6e 8b 6b 16 af 20 18 06 .4..@.,. n.k.. ..
0020 ad dc 00 50 4e 18 18 52 ff f8 e6 a4 dd 0f 80 12 ...PN..R ....
0030 16 d0 4d af 00 00 02 04 05 b4 01 01 04 02 01 03 ..M..... ....
0040 03 08 ..
Time to live (ip.ttl), 1 byte
Packets: 4900 Displayed: 4900 Ma...
Profile: Default

Sort Column Contents

Columns make the analysis process faster, but there are two other great reasons to create columns:

columns can be sorted and column data can be exported.

Click on a column heading once to sort from low to high and click again to sort from high to low. If

you have added a column showing the delays between packets, you can sort this column to quickly

find the largest delays in the trace file. We will use this technique in *Configure Time Columns to Spot*

Latency Problems.

For example, in Figure 25 we opened *http-espn101.pcapng* and right-clicked once on the **Time to live**

column heading to sort the column from low to high. Scrolling to the top of the trace file, we

determined that the lowest TTL value in the trace file is 44.

Figure 25. We sorted the Time to live field to find the lowest TTL value in the trace file. [http–espn101.pcapng]

Export Column Data

Another great reason to add columns to the Packet List pane is to export those columns for analysis

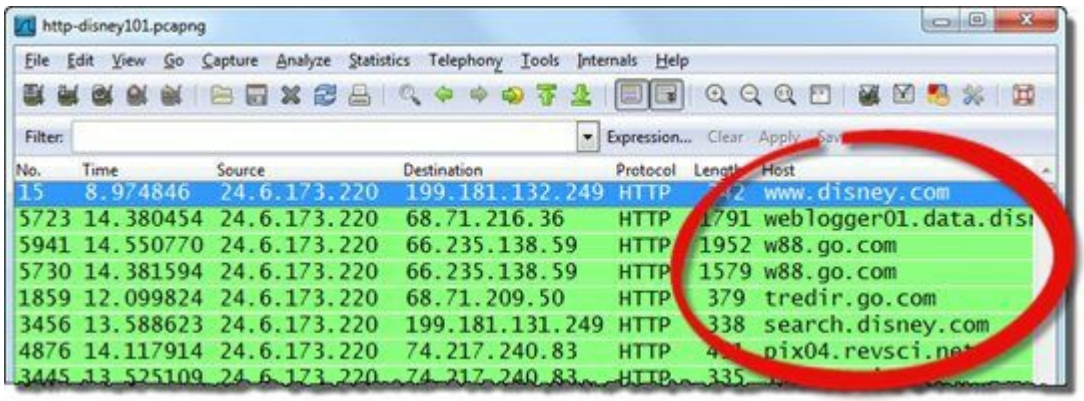
with another tool. For example, if you added a **Time to Live** column, you can select **File | Export**

Packet Dissections and choose **CSV** (comma-separated value) format. Choose to export only the

Summary information and you'll end up with a CSV file containing your new column data. You can

now open this CSV file in a spreadsheet to manipulate the data further. You will get a chance to

practice exporting to CSV format in Lab 30 and Lab 41.


http-disney101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply
No. Time Source Destination Protocol Length Host
15 8.974846 24.6.173.220 199.181.132.249 HTTP www.disney.com
5723 14.380454 24.6.173.220 68.71.216.36 HTTP 1791 weblogger01.data.dis
5941 14.550770 24.6.173.220 66.235.138.59 HTTP 1952 w88.go.com
5730 14.381594 24.6.173.220 66.235.138.59 HTTP 1579 w88.go.com
1859 12.099824 24.6.173.220 68.71.209.50 HTTP 379 tredir.go.com
3456 13.588623 24.6.173.220 199.181.131.249 HTTP 338 search.disney.com
4876 14.117914 24.6.173.220 74.217.240.83 HTTP pix04.revsci.net

Lab 4: Add the HTTP Host Field as a Column

During a browsing session, an HTTP client sends requests for HTTP objects to one or more HTTP

servers. In each of the requests, the client specifies the name or the IP address of the target HTTP

server. This can be very revealing.

***Note**: All frames from 24.6.173.220 will appear with a black background and red foreground if*

Wireshark is set to validate IP header checksums. You will disable this feature in Lab 6.

Step 1: Click the **File Open** button

on the main toolbar and open ***http–disney101.pcapng***.

Step 2: Scroll down in the Packet List pane and select **frame 15**.

Step 3: The Packet Details pane shows the contents of frame 15. Click the **+** in front of Hypertext

Transfer Protocol to expand this section of the frame.

Step 4: Right-click on the **Host** line (which contains www.disney.com\r\n) and select **Apply as**

Column. Your new **Host** column appears to the left of the **Info** column. You can click and drag the column edges to widen the column.

Step 5: Click on the **Host** column twice to sort from high to low.

Step 6: Click the **Go to First** button

to jump to the top of the sorted trace file. You can now easily

see all the hosts to which the client sent requests, as shown below.

Step 7: Lab Clean-up Right-click on your new **Host** column heading and select **Hide Column**. If you want to view this column again, right-click any column heading and select **Displayed Columns | Host**

(http.host).

Adding and sorting columns are two key tasks that can shorten your analysis time significantly. Why

go searching through thousands of packets when you can have Wireshark quickly gather and display

the information you need?

1.2. Dissect the Wireshark Dissectors

Packet dissection is one of the most powerful features of Wireshark. The dissection process converts

streams of bytes into understandable requests, replies, refusals, retransmissions, and more.

Frames are handed up from either the Capture Engine or Wiretap Library to the *Core Engine*. The

Core Engine is referred to as the "glue code that holds the other blocks together." This is where the

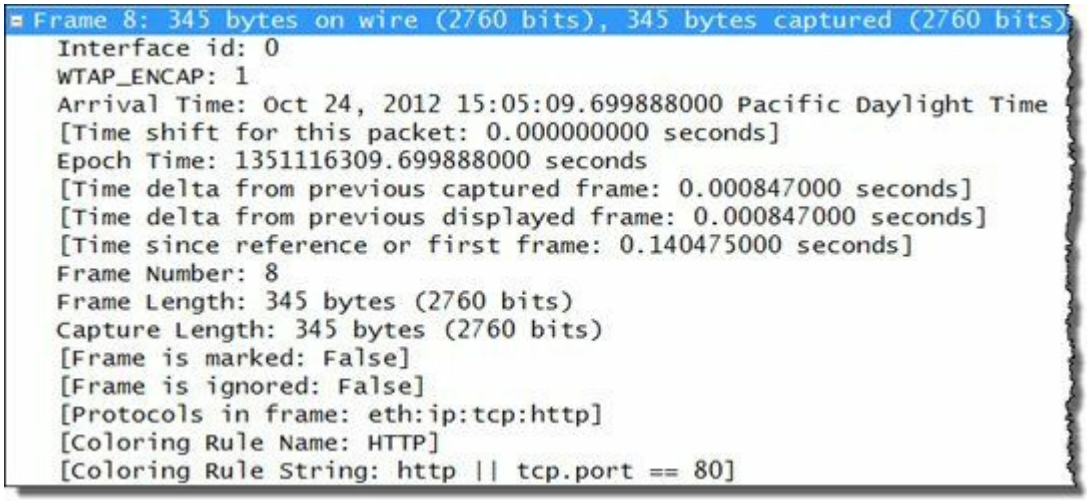
real work begins. Wireshark understands the format used by thousands of protocols and applications.

Wireshark calls on various dissectors to break apart fields and display their meanings in readable

format.

For example, consider a host on an Ethernet network that issues an HTTP GET request to a web site.

This packet will be handled by five dissectors.


Frame 8: 345 bytes on wire (2760 bits), 345 bytes captured (2760 bits)
Interface id: 0
WTAP_ENCAP: 1
Arrival Time: Oct 24, 2012 15:05:09.699888000 Pacific Daylight Time
[Time shift for this packet: 0.000000000 seconds]
Epoch Time: 1351116309.699888000 seconds
[Time delta from previous captured frame: 0.000847000 seconds]
[Time delta from previous displayed frame: 0.000847000 seconds]
[Time since reference or first frame: 0.140475000 seconds]
Frame Number: 8
Frame Length: 345 bytes (2760 bits)
Capture Length: 345 bytes (2760 bits)
[Frame is marked: False]
[Frame is ignored: False]
[Protocols in frame: eth:ip:tcp:http]
[Coloring Rule Name: HTTP]
[Coloring Rule String: http || tcp.port == 80]

The Frame Dissector

The Frame dissector (seen in Figure 26) examines and displays the trace file basic information, such

as the timestamp set on each of the frames. Then the Frame dissector hands the frame off to the

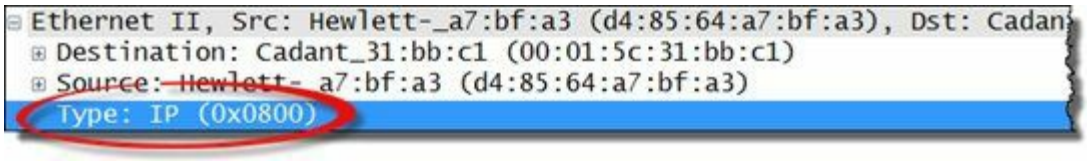
Ethernet dissector.

Figure 26. The Frame dissector displays metadata (extra information) about the frame. [http–chappellu101.pcapng]

Every once in a while a dissector bug surfaces. They typically appear as "exception occurred"

*in the **Info** column of the Packet List pane. If you want to validate the bug, you can search for*

the protocol as a keyword on the Wireshark Bug Database at bugs.wireshark.org/bugzilla/ .


Ethernet II, Src: Hewlett-_a7:bf:a3 (d4:85:64:a7:bf:a3), Dst: Cadan
Destination: Cadant_31:bb:c1 (00:01:5c:31:bb:c1)
Source: Hewlett- a7:bf:a3 (d4:85:64:a7:bf:a3)
Type: IP (0x0800)

The Ethernet Dissector Takes Over

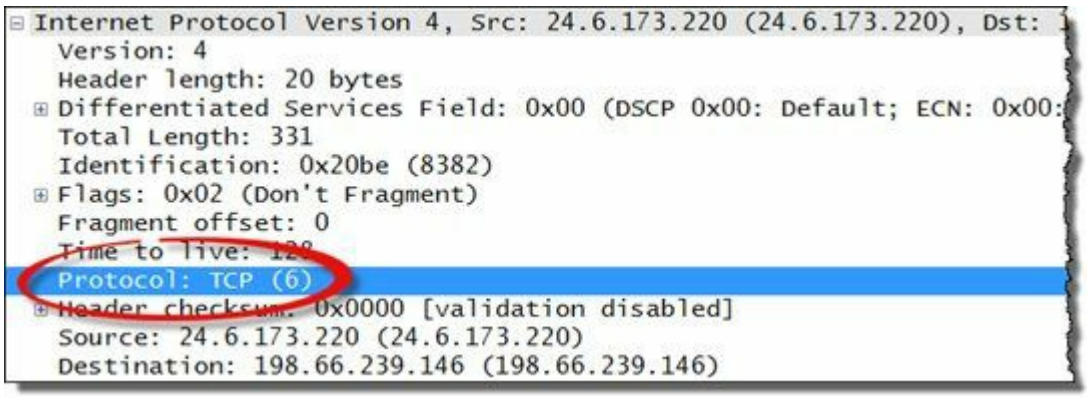
The Ethernet dissector decodes and displays the fields of the Ethernet II header and, based on the

contents of the Type field, hands the packet off to the next dissector. In Figure 27, the Type field value

0x0800 indicates that an IPv4 header will follow. Notice that at this point, when we remove the

Ethernet frame from the dissection, we are using the term "packet."

Figure 27. The Ethernet dissector looks at the Type field to determine the next required dissector. [http–chappellu101.pcapng]


Internet Protocol Version 4, Src: 24.6.173.220 (24.6.173.220), Dst:
Version: 4
Header length: 20 bytes
Differentiated Services Field: 0x00 (DSCP 0x00: Default; ECN: 0x00:
Total Length: 331
Identification: 0x20be (8382)
Flags: 0x02 (Don't Fragment)
Fragment offset: 0
Time to live: 128
Protocol: TCP (6)
Header checksum: 0x0000 [validation disabled]
Source: 24.6.173.220 (24.6.173.220)
Destination: 198.66.239.146 (198.66.239.146)

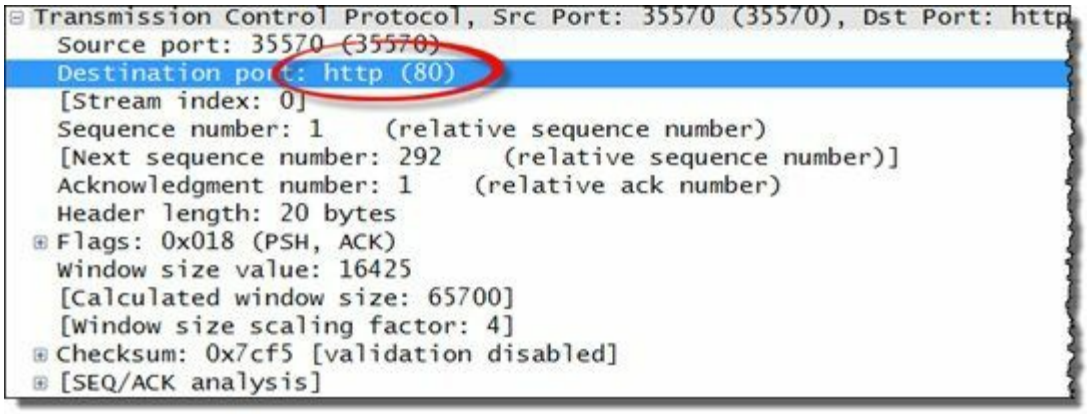
The IPv4 Dissector Takes Over

The IPv4 dissector decodes the fields of the IPv4 header and, based on the contents of the Protocol

field, hands the packet off to the next dissector. In Figure 28, the Protocol field value 6 indicates that

TCP will follow.

Figure 28. The IPv4 dissector looks at the Protocol field to determine the next required dissector. [http–chappellu101.pcapng]


Transmission Control Protocol, Src Port: 35570 (35570), Dst Port: http
Source port: 35570 (35570)
Destination port: http (80)
[Stream index: 0]
Sequence number: 1 (relative sequence number)
[Next sequence number: 292 (relative sequence number)]
Acknowledgment number: 1 (relative ack number)
Header length: 20 bytes
Flags: 0x018 (PSH, ACK)
Window size value: 16425
[Calculated window size: 65700]
[Window size scaling factor: 4]
Checksum: 0x7cf5 [validation disabled]
[SEQ/ACK analysis]

The TCP Dissector Takes Over

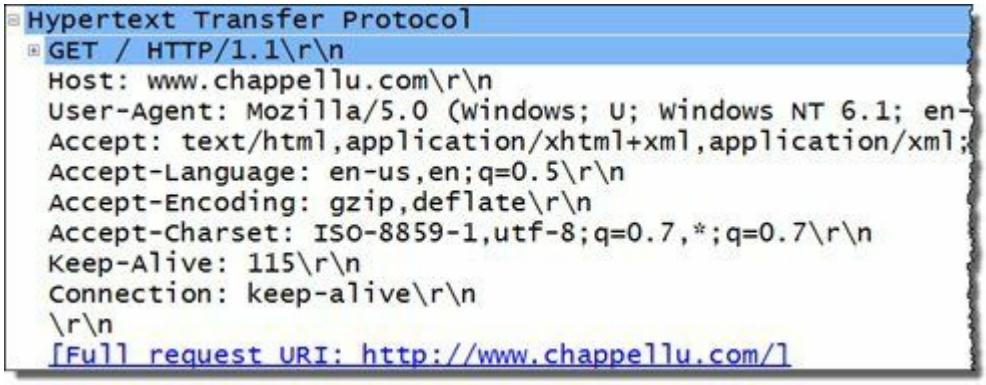
The TCP dissector decodes the fields of the TCP header and, based on the contents of the Port fields,

hands the packet off to the next dissector. In Figure 29, the destination port value 80 indicates that

HTTP will follow. We will see how Wireshark handles traffic running over non-standard port numbers

in the next section.

Figure 29. The TCP dissector looks at the port fields to determine the next required dissector. [http–chappellu101.pcapng]



The HTTP Dissector Takes Over

In this example, the HTTP dissector decodes the fields of the HTTP packet. There is no embedded

protocol or application inside the HTTP packet, so this is the last dissector applied to the frame, as

shown in Figure 30.

Figure 30. The HTTP dissector does not see any indication that the packet should be handed off to another dissector. [http-chappellu101.pcapng]

In the next section we will look at how Wireshark handles traffic running over a non-standard port

number.

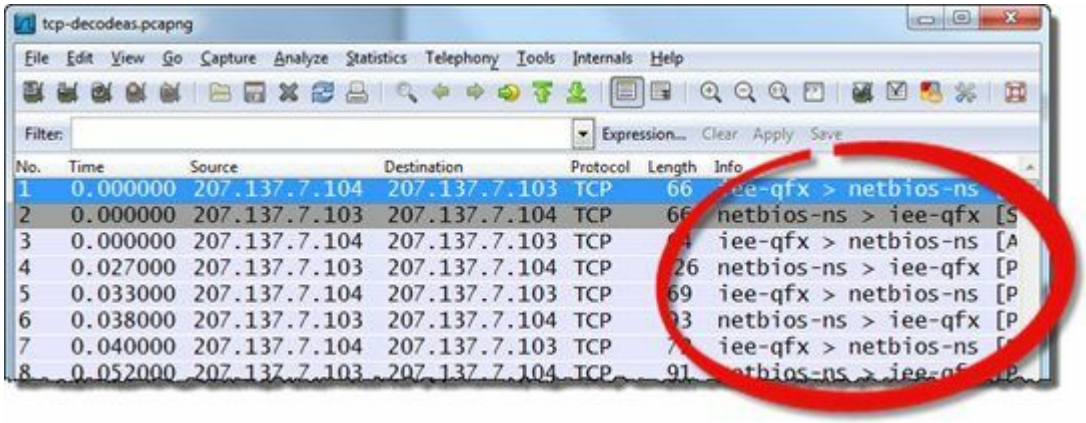
1.3. Analyze Traffic that Uses Non-Standard

Port Numbers

Applications running over non-standard port numbers are always a concern to network analysts,

whether the application is intentionally designed to use those non-standard port numbers or it is

surreptitiously trying to get through a firewall.


tcp-decodeas.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
1 0.000000 207.137.7.104 207.137.7.103 TCP 66
2 0.000000 207.137.7.103 207.137.7.104 TCP 66 netbios-ns > iee-qfx [S
3 0.000000 207.137.7.104 207.137.7.103 TCP iee-qfx > netbios-ns [A
4 0.027000 207.137.7.103 207.137.7.104 TCP 26 netbios-ns > iee-qfx [P
5 0.033000 207.137.7.104 207.137.7.103 TCP 69 iee-qfx > netbios-ns [P
6 0.038000 207.137.7.103 207.137.7.104 TCP 93 netbios-ns > iee-qfx [P
7 0.040000 207.137.7.104 207.137.7.103 TCP iee-qfx > netbios-ns
8 0.052000 207.137.7.103 207.137.7.104 TCP 91

When the Port Number is Assigned to Another Application

What if your traffic runs over a non-standard port number that Wireshark recognizes as used by

another application? Wireshark may apply the wrong dissector. In Figure 31, we have an

FTP communication running over port number 137. Wireshark recognizes this port number as

NetBIOS Name Service traffic.

Normal NetBIOS traffic does not look like this. Wireshark indicates TCP in the **Protocol** column

while placing "netbios-ns" in the port area of the **Info** column. Scrolling through this file, the contents in the **Info** column do not contain normal NetBIOS Name Service details.

Figure 31. When an application uses a non-standard port that Wireshark recognizes, the incorrect dissector may be applied. [tcp-decodeas.pcapng]

Manually Force a Dissector on the Traffic

There are two reasons why you may want to manually force a dissector onto traffic: (1) if Wireshark

applies the wrong dissector because the non-standard port number is already associated with a

dissector (as we see in Figure 31), or (2) if Wireshark doesn't have a heuristic dissector for your traffic

type. We'll look at heuristic dissectors next.

To force a dissector on traffic, right-click on the undissected/incorrectly dissected packet in the Packet

List pane and select **Decode As**. Select the **Transport** tab (showing the port number to be forcibly

dissected) and choose the desired dissector. You'll practice this process in Lab 5**.**

When the Port Number is not Recognized

There may be a situation when traffic runs over a non-standard port number that is not assigned to

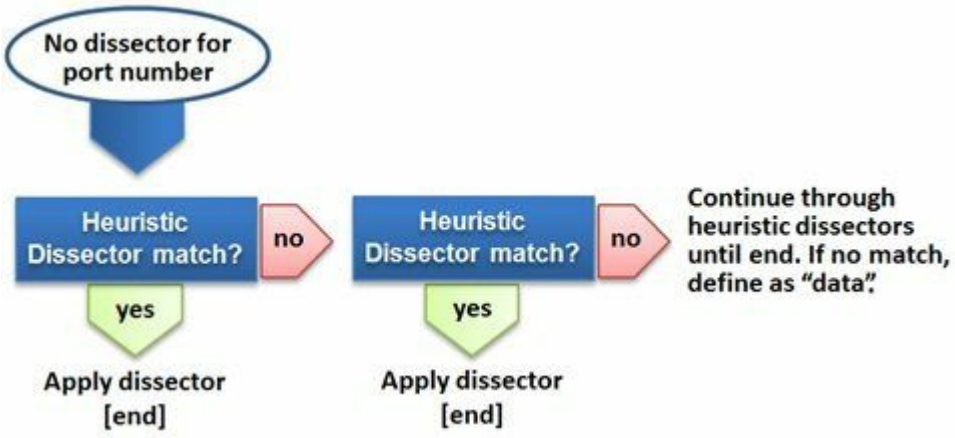
another application. For example, perhaps your company runs web services on port 48600. Wireshark

doesn't have a dissector that recognizes this port number, so it considers the bytes following the TCP

header as just "data."

In this case, Wireshark uses *heuristic dissectors* to try to decode the data into some recognizable

protocol or application.



How Heuristic Dissectors Work

Wireshark hands the data off to the first of many available *heuristic dissectors,* as illustrated in Figure 32. Each heuristic dissector looks for recognizable patterns in the data to figure out what type of

communication is contained in the packet. If the heuristic dissector doesn't recognize anything, it

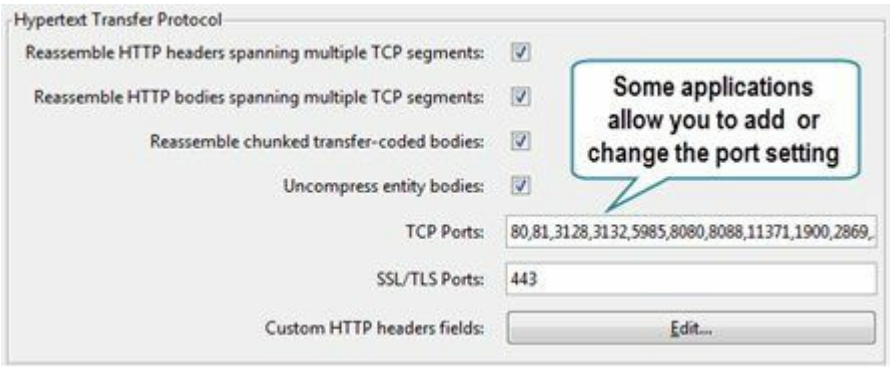
returns a failure indication to Wireshark. Wireshark then hands the data off to the next heuristic

dissector. Wireshark continues to hand the data off to heuristic dissectors until (a) a heuristic dissector

returns an indicator of success and decodes the traffic, or (b) Wireshark runs out of heuristic

dissectors to try.

Figure 32. Wireshark applies heuristic dissectors until it is successful or simply marks the undissected bytes as "data".



Adjust Dissections with the Application Preference Settings (if

possible)

If you know that certain traffic, such as HTTP traffic, runs over a non-standard port on your network,

you can add the port to the HTTP protocol's preference settings. For example, perhaps you want

Wireshark to dissect traffic to or from port 81 as HTTP traffic. Select **Edit | Preferences |**

(+) Protocols | HTTP and add 81 to the port list, as shown in Figure 33.

Figure 33. We added port 81 to the list of TCP ports that should be dissected as HTTP traffic.

Not all application preferences have configurable port values. If your application is not listed in the

Protocols section, or your application does allow you to add or change the port setting, you will need

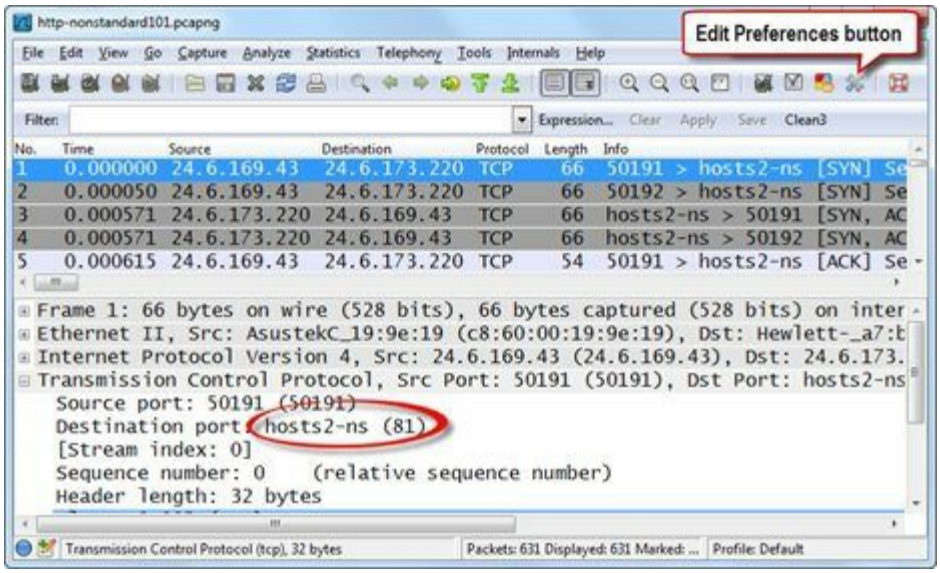
to manually force a dissector on the traffic as shown in *Manually Force a Dissector on the Traffic.*

You can determine that Wireshark is unable to apply a dissector to some of your frames by

selecting ***Statistics | Protocol Hierarchy*** *and looking for "data" under the TCP or UDP*

sections. You will work with the Protocol Hierarchy window in List Applications Seen on the

Network.


http-nonstandard101.pcapng
Edit Preferences button
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save Clean3
No. Time Source Destination Protocol Length Info
1 0.000000 24.6.169.43 24.6.173.220 TCP 66 50191 > hosts2-ns [SYN] Se
2 0.000050 24.6.169.43 24.6.173.220 TCP 66 50192 > hosts2-ns [SYN] Se
3 0.000571 24.6.173.220 24.6.169.43 TCP 66 hosts2-ns > 50191 [SYN, AC
4 0.000571 24.6.173.220 24.6.169.43 TCP 66 hosts2-ns > 50192 [SYN, AC
5 0.000615 24.6.169.43 24.6.173.220 TCP 54 50191 > hosts2-ns [ACK] Se
Frame 1: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on inter
Ethernet II, Src: AsustekC_19:9e:19 (c8:60:00:19:9e:19), Dst: Hewlett-_a7:b
Internet Protocol Version 4, Src: 24.6.169.43 (24.6.169.43), Dst: 24.6.173.
Transmission Control Protocol, Src Port: 50191 (50191), Dst Port: hosts2-ns
Source port: 50191 (50191)
Destination port: hosts2-ns (81)
[Stream index: 0]
Sequence number: 0 (relative sequence number)
Header length: 32 bytes
Transmission Control Protocol (tcp), 32 bytes
Packets: 631 Displayed: 631 Marked: ...
Profile: Default

Lab 5: Configure Wireshark to Dissect Port 81 Traffic as

HTTP

You have been given a trace file that contains an HTTP session, but your customer uses port 81

instead of port 80 on their HTTP server. In this lab you will get a chance to enhance Wireshark's

HTTP dissection capability to include an extra port number.

***Note**: All frames from 24.6.173.220 will appear with a black background and red foreground if*

Wireshark is set to validate IP header checksums. You will disable this feature in Lab 6.

Step 1: Open ***http-nonstandard101.pcapng*** and examine the Packet List pane. This does not look like HTTP traffic. The **Protocol** column simply lists TCP for all the packets. Wireshark indicates that

traffic is being sent from the client ports 50191 through 50197 to port 81 (which is recognized as

hosts2-ns by Wireshark's *services* file). We will discuss Wireshark's *services* file in the next section.

Step 2: Click on the **Edit Preferences**

button on the main toolbar.

Step 3: Expand the **Protocols** section and type **HTTP** to quickly jump to that configuration area. Add **81** to the port number list and click **OK**.

Step 4: Scroll through the trace file. Your traffic is now dissected as TCP (TCP handshakes and

ACKs) and HTTP.

Step 5: Lab Clean-up Since you likely do not have HTTP traffic running over port 81, return to the

HTTP port preference setting, and remove **81**. Click **OK** to save your new setting.

Scroll through the protocols listed in the Preferences area. There are many applications that allow

setting ports in this manner. This is an easy way to change Wireshark's dissection methods.

1.4. Change how Wireshark Displays Certain

Traffic Types

Wireshark is a well-formed piece of clay. Nevertheless, it is in a default state when you install it.

Customizing Wireshark will make you and your analysis sessions more effective.

You learned how to add columns using the Preferences settings, but there is so much more you can do.

Let's take a look at these key preference settings.

Set User Interface Settings

Select **Edit | Preferences | User Interface** to change many of the basic preferences for your interface

here. You will change two of the User Interface settings in Lab 6.

Set Name Resolution Settings

Select **Edit | Preferences | Name Resolution** to view or change the way Wireshark deals with MAC

address, port, and IP address resolution.

MAC name resolution: By default, Wireshark resolves the first three bytes of the MAC addresses

(the OUI) to friendly names using the *manuf* file in the Wireshark program file directory.

Transport name resolution: Transport names, such as "ftp" instead of port 21 are resolved using the *services* file in the Wireshark program file directory and displayed in the Info column of the Packet

List pane.

Host name resolution: If you want Wireshark to resolve host names (for example, showing

www.wireshark.org instead of an IP address), enable Network Name Resolution. Be aware, however,

that enabling this setting without creating a *hosts* file for Wireshark to use, can cause Wireshark to

send DNS Pointer (PTR) queries to obtain host names. This extra traffic will show up in your trace

files and may create extra work for your DNS server.[15]

You can also set name resolution through **View | Name Resolution**, however this is only a temporary

setting. Settings changed in the Preferences window are retained with the current profile.

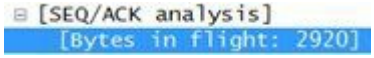
Define Filter Expression Buttons

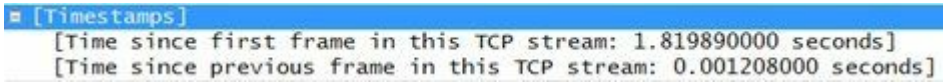
You can select **Edit | Preferences | Filter Expressions** to save your favorite display filters as buttons

to apply them more quickly to your trace files. There is a faster way to create these buttons, however.

We will cover the process of making Filter Expression buttons in *Turn Your Key Display Filters into*

Buttons.




[Timestamps]
[Time since first frame in this TCP stream: 1.819890000 seconds]
[Time since previous frame in this TCP stream: 0.001208000 seconds]

Set Protocol and Application Settings

Although you can select **Edit | Preferences | (+) Protocols** to view all the protocols and applications

that contain editable settings, the right-click method is a faster way to define protocol settings. In

Lab 6 you will use the right-click method to view and change several protocol settings:

Allow subdissector to reassemble TCP streams: This setting is enabled by default, but it can

cause problems when analyzing HTTP traffic. If an HTTP server answers a client request with a

response code (such as 200 OK) and it includes some of the requested file in the packet,

Wireshark does not display the response code. Instead, Wireshark displays "[TCP Segment of a

Reassembled PDU]" (Protocol Data Unit). We would much rather see the response codes, as

shown below.

TCP reassembly *enabled*:

TCP reassembly *disabled*:

You can disable the TCP reassembly preference setting until you want to export files that were

transferred in an HTTP communication (see *View all HTTP Objects in the Trace File*).

***Track number of bytes in flight*:** Data bytes that are sent across a TCP connection, but are not acknowledged yet, are considered "bytes in flight." We can configure Wireshark to show us how

much unacknowledged data is currently seen in a TCP communication. If the number seems to hit

a "ceiling," some TCP setting may be limiting data flow capabilities. When you enable this

setting, a new section (shown below) is appended to the TCP header section in the Packet Details

pane. This new field will not be displayed until after the TCP connection is established.

Track number of bytes in flight enabled:

Calculate conversation timestamps: This TCP setting tracks time values within each separate

TCP conversation. This enables you to obtain timestamp values based on the first frame in a

single TCP conversation or the previous frame in a single TCP conversation. When you enable

this setting, a new section (shown below) is appended to the TCP header section in the Packet

Details pane.

You will enable these settings in Lab 6 and examine their effect on the Wireshark Packet List pane

and Packet Details pane.

Lab 6: Set Key Wireshark Preferences (IMPORTANT LAB)[16]

Wireshark offers several key preference settings to enhance your analysis sessions. In this lab you will

use the **Edit Preferences** button on the main toolbar and the right-click method to view and change

the preference settings.

These are the settings we will view and alter in this lab:

Increase the number of display filters that Wireshark will remember.

Increase the number of recently opened files that Wireshark will remember.

Ensure IP, UDP, and TCP checksum validations are disabled.

Enable the TCP *Calculate conversation timestamps* setting.

Enable the TCP *Track number of bytes in flight* setting.

Disable the TCP *Allow subdissector to reassemble TCP streams* setting.

Note: Your Wireshark system should retain all of these settings through the rest of this book with the

exception of the TCP *Allow subdissector to reassemble TCP streams* setting, which you will work with

during various labs.

Step 1: Open ***http-pcaprnet101.pcapng***.

Step 2: Click the **Edit Preferences** button

on the main toolbar.

Step 3: Change both the **Filter display max. list entries** and **"Open Recent" max. list entries** settings to **30**. These two settings allow you to quickly recall more of your recent filter settings and

opened files.

Step 4: Click **OK**. This automatically applies and saves your settings in this *Default* profile and closes the Preferences window. Next we will use the right-click method to check and change the IP, UDP,

and TCP settings. The first task is to disable IP, UDP, and TCP checksum validation. These three

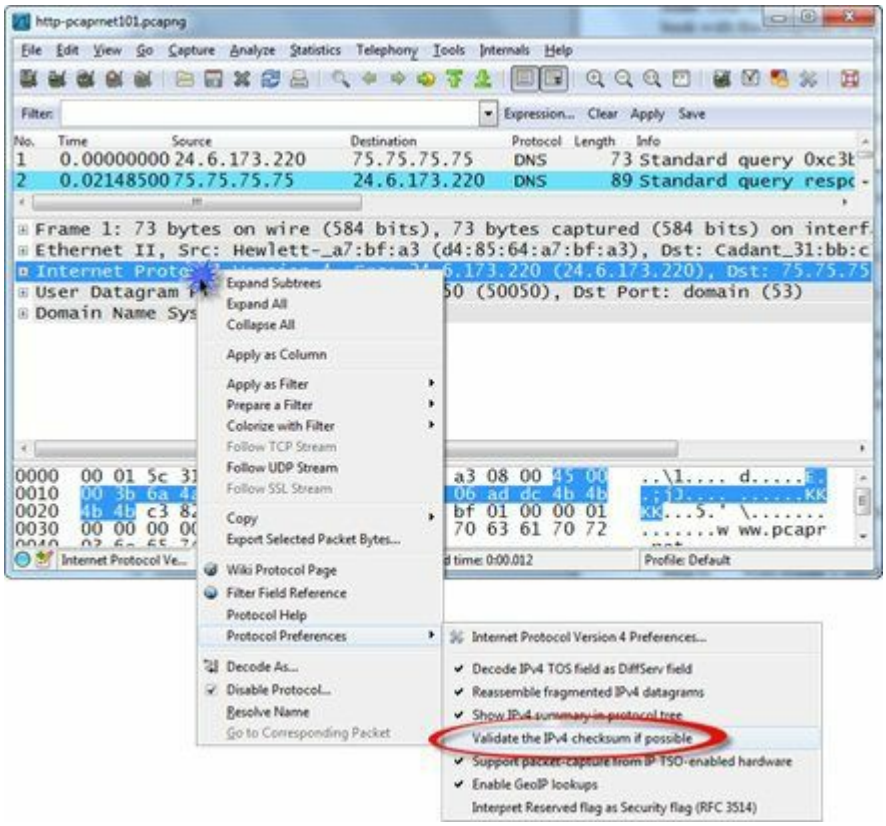
checksum validations should already be disabled unless you updated Wireshark while retaining

previous settings.

Step 5: With frame 1 selected in the Packet List pane, right-click on the **Internet Protocol** section of the Packet Details pane and hover over the **Protocol Preferences** option on the drop-down menu. If

this setting is enabled (checked), click on the **Validate the IPv4 checksum if possible** setting to

disable it.


http-pcapnet101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
1 0.00000000 24.6.173.220 75.75.75.75 DNS 73 Standard query 0xc3b
2 0.02148500 75.75.75.75 24.6.173.220 DNS 89 Standard query respc
Frame 1: 73 bytes on wire (584 bits), 73 bytes captured (584 bits) on interf
Ethernet II, Src: Hewlett-_a7:bf:a3 (d4:85:64:a7:bf:a3), Dst: Cadant_31:bb:c
Internet Proto
User Datagram
Domain Name Sys
6.173.220 (24.6.173.220), Dst: 75.75.75
50 (50050), Dst Port: domain (53)
0000 00 01 5c 31
0010 00 3b 6a 4
0020 4b 4b c3 8
0030 00 00 00 0
a3 08 00 45 00
06 ad dc 4b 4b
bf 01 00 00 01
70 63 61 70 72
..\1.... d.....E.
.;j.... .....KK
KK...5.' \.....
.....w ww.pcapr
Internet Protocol Ve...
d time: 0:00.012
Profile: Default
Expand Subtrees
Expand All
Collapse All
Apply as Column
Apply as Filter
Prepare a Filter
Colorize with Filter
Follow TCP Stream
Follow UDP Stream
Follow SSL Stream
Copy
Export Selected Packet Bytes...
Wiki Protocol Page
Filter Field Reference
Protocol Help
Protocol Preferences
Decode As...
Disable Protocol...
Resolve Name
Go to Corresponding Packet
Internet Protocol Version 4 Preferences...
Decode IPv4 TOS field as DiffServ field
Reassemble fragmented IPv4 datagrams
Show IPv4 summary in protocol tree
Validate the IPv4 checksum if possible
Support packet-capture from IP TSO-enabled hardware
Enable GeoIP lookups
Interpret Reserved flag as Security flag (RFC 3514)

Step 6: Again, in frame 1, right-click the **User Datagram Protocol** section of the Packet Details pane and hover over the **Protocol Preferences** option from the drop-down menu. Uncheck **Validate the**

UDP checksum if possible setting if it is currently enabled.

Step 7: Select **frame 5** in the Packet List pane. Right-click the **Transmission Control Protocol**

section of the Packet Details pane and, under **Protocol Preferences**, disable the **Validate the TCP**

checksum if possible setting if it is currently enabled.

Step 8: Since Wireshark closes the TCP protocol settings menu after you select an option, you must

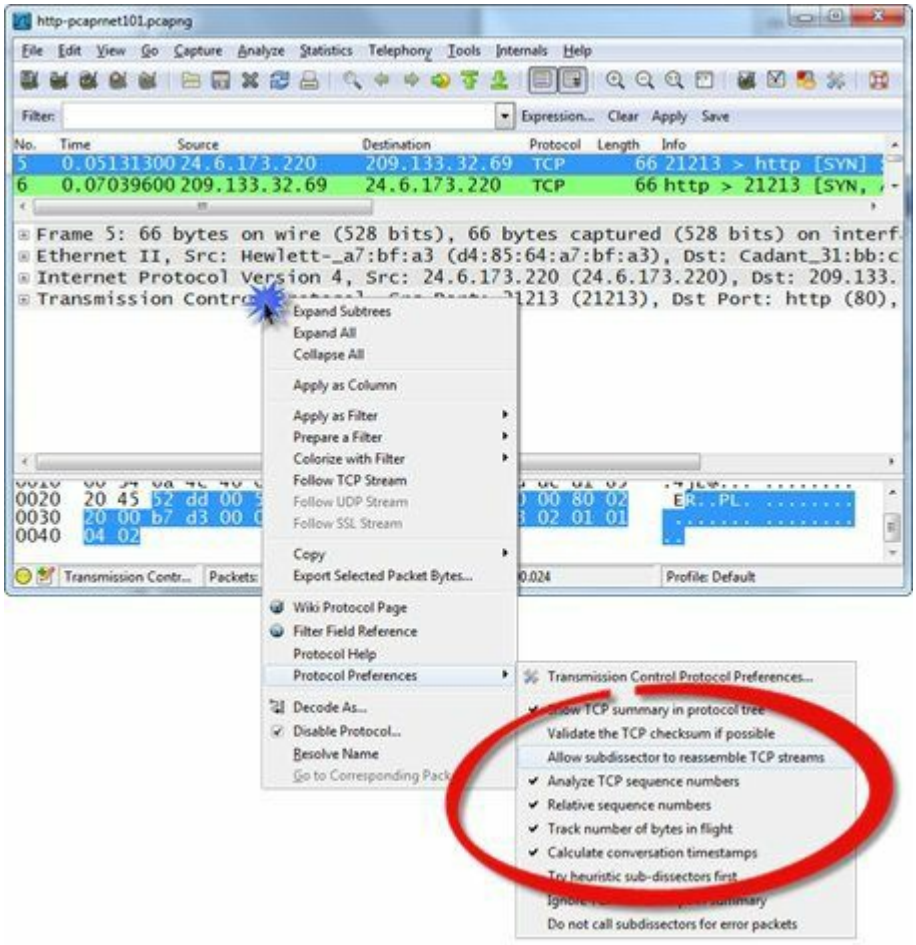
right-click again on the **Transmission Control Protocol** section of the Packet Details pane to change

the following additional settings.

disable ***Allow subdissector to reassemble TCP streams***

enable ***Track number of bytes in flight***

enable ***Calculate conversation timestamps***


http-pcaprnet101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
5 0.05131300 24.6.173.220 209.133.32.69 TCP 66 21213 > http [SYN]
6 0.07039600 209.133.32.69 24.6.173.220 TCP 66 http > 21213 [SYN,
Frame 5: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interf
Ethernet II, Src: Hewlett-_a7:bf:a3 (d4:85:64:a7:bf:a3), Dst: Cadant_31:bb:c
Internet Protocol Version 4, Src: 24.6.173.220 (24.6.173.220), Dst: 209.133.
Transmission Contro
1213 (21213), Dst Port: http (80),
0020 20 45
0030 20 00 b7 d3 00
0040 04 02
Expand Subtrees
Expand All
Collapse All
Apply as Column
Apply as Filter
Prepare a Filter
Colorize with Filter
Follow TCP Stream
Follow UDP Stream
Follow SSL Stream
Copy
Export Selected Packet Bytes...
Wiki Protocol Page
Filter Field Reference
Protocol Help
Protocol Preferences
Decode As...
Disable Protocol...
Resolve Name
Transmission Control Protocol Preferences...
Validate the TCP checksum if possible
Allow subdissector to reassemble TCP streams
Analyze TCP sequence numbers
Relative sequence numbers
Track number of bytes in flight
Calculate conversation timestamps
Try heuristic sub-dissectors first
Do not call subdissectors for error packets
Transmission Contr...
Packets:
Profile: Default

Step 9: Now let's see how a few of these settings affect the packet displays. Click on **frame 8** in ***http-***

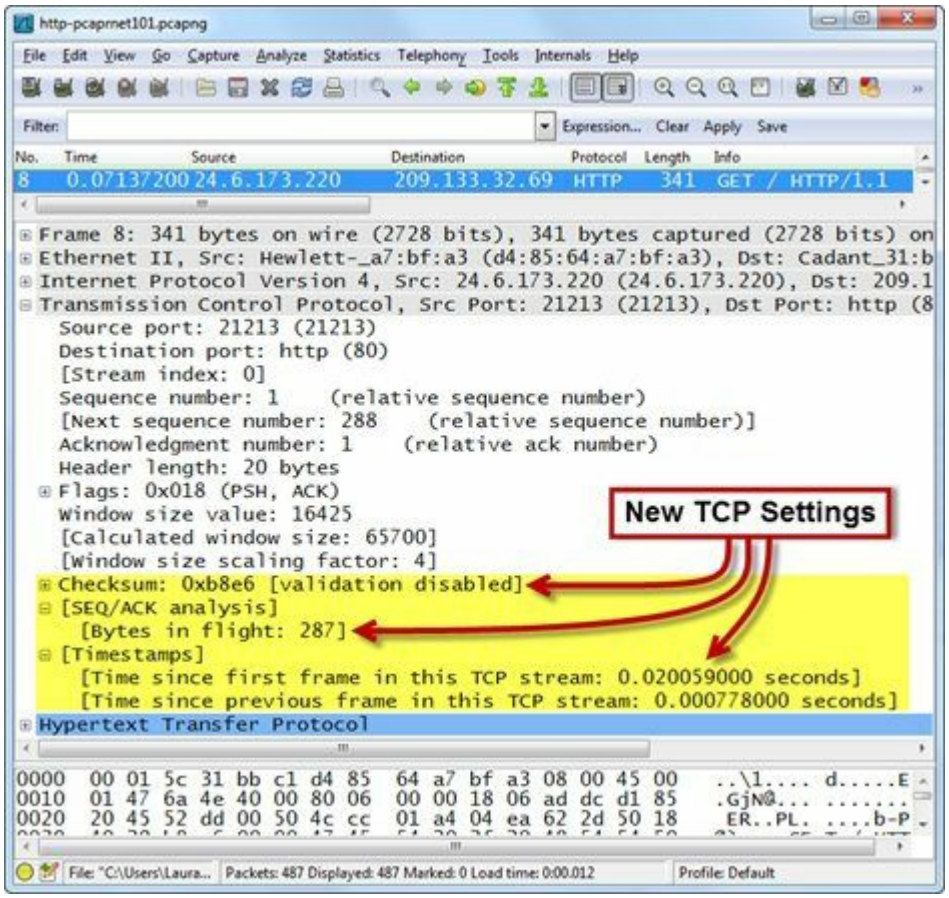
pcaprnet101.pcapng. Expand the **Transmission Control Protocol line**, the **SEQ/ACK analysis**, and **Timestamps** section in the Packet Details pane. We can see that Wireshark is not validating the TCP

checksum and that 287 bytes of data have been sent, but not acknowledged. In addition, we can see

that this frame arrived about 20 milliseconds (0.020 seconds) after the first frame of the TCP

conversation (also referred to as the TCP stream) and 778 microseconds (0.000778 seconds) after the

previous frame of this TCP conversation.


http-pcapmet101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
8 0.07137200 24.6.173.220 209.133.32.69 HTTP 341 GET / HTTP/1.1
Frame 8: 341 bytes on wire (2728 bits), 341 bytes captured (2728 bits) on
Ethernet II, Src: Hewlett-_a7:bf:a3 (d4:85:64:a7:bf:a3), Dst: Cadant_31:b
Internet Protocol Version 4, Src: 24.6.173.220 (24.6.173.220), Dst: 209.1
Transmission Control Protocol, Src Port: 21213 (21213), Dst Port: http (8
Source port: 21213 (21213)
Destination port: http (80)
[Stream index: 0]
Sequence number: 1 (relative sequence number)
[Next sequence number: 288 (relative sequence number)]
Acknowledgment number: 1 (relative ack number)
Header length: 20 bytes
Flags: 0x018 (PSH, ACK)
Window size value: 16425
[Calculated window size: 65700]
[Window size scaling factor: 4]
Checksum: 0xb8e6 [validation disabled]
[SEQ/ACK analysis]
[Bytes in flight: 287]
[Timestamps]
[Time since first frame in this TCP stream: 0.020059000 seconds]
[Time since previous frame in this TCP stream: 0.000778000 seconds]
Hypertext Transfer Protocol
New TCP Settings
0000 00 01 5c 31 bb c1 d4 85 64 a7 bf a3 08 00 45 00
0010 01 47 6a 4e 40 00 80 06 00 00 18 06 ad dc d1 85
0020 20 45 52 dd 00 50 4c cc 01 a4 04 ea 62 2d 50 18
Packets: 487 Displayed: 487 Marked: 0 Load time: 0:00.012
Profile: Default

You can easily use the right-click method to change protocol preferences, such as tracking time in

each TCP conversation and the number of unacknowledged bytes in a conversation. There are many

other application and protocol preference settings that can be set in either the Preferences window or

through the right-click method.

1.5. Customize Wireshark for Different

Tasks (Profiles)

There are certain customization characteristics that fit troubleshooting tasks while other customized

settings may fit network forensics tasks. Profiles enable you define separate Wireshark configurations

for these different analysis processes.

The Basics of Profiles

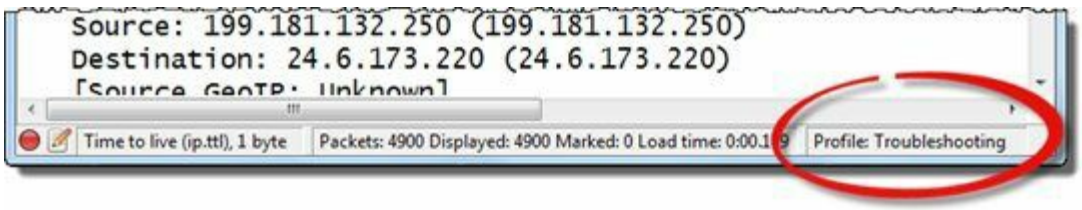
Profiles are basically directories that contain Wireshark configuration and support files that are loaded

by Wireshark when you select to work in each profile. For example, you may create a profile focused

on security concerns. This "security profile" may contain filters to display all ICMP traffic or

connection attempts traveling in the direction of clients (as opposed to servers) and coloring rules that

highlight suspicious traffic that contains known signatures.


Source: 199.181.132.250 (199.181.132.250)
Destination: 24.6.173.220 (24.6.173.220)
Time to live (ip.ttl), 1 byte
Packets: 4900 Displayed: 4900 Marked: 0 Load time: 0:00.1
Profile: Troubleshooting

TIP

Create a New Profile

Right-click on the **Profile** column in the Status Bar and select **New** to create a new profile and name it **Troubleshooting**. All the capture filter settings, display filter settings, coloring rules, columns, and

preference settings you set now will be saved in that Troubleshooting profile. Alternately you can

select **Edit | Configuration Profiles...** to create a new profile. [17]

The name of the profile you are working in is displayed in the right-hand column of the Status bar. In

Figure 34, we are working in our Troubleshooting profile. Consider creating a different profile for

security analysis, WLAN analysis, or any other type of analysis functions you perform.

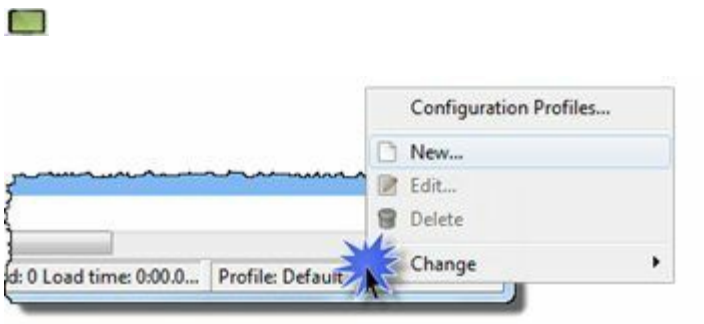
Figure 34. The right column in the Status Bar indicates the profile in use.

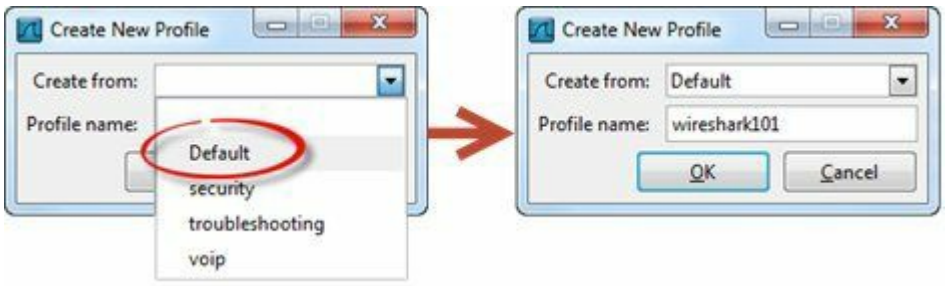
Profiles are a collection of simple text files that define preference settings, capture filters,

display filters, coloring rules, and more. If you want to copy part or all of a profile to another

Wireshark host, simply copy the profile directory (or the individual files in the profile's

directory) to the other host.





Lab 7: Create a New Profile Based on the *Default* Profile

Profiles enable you to work with customized settings to be more efficient when analyzing traffic. In

this lab you will create a new profile called " *wireshark101*." You will base it on your *Default* profile to ensure any previously created settings will be copied over to your new profile.

Step 1: Right-click on the **Profile** column in the Status Bar and select **New**.

Step 2: Select ***Default*** from the drop down list of available profiles and name your profile

wireshark101.

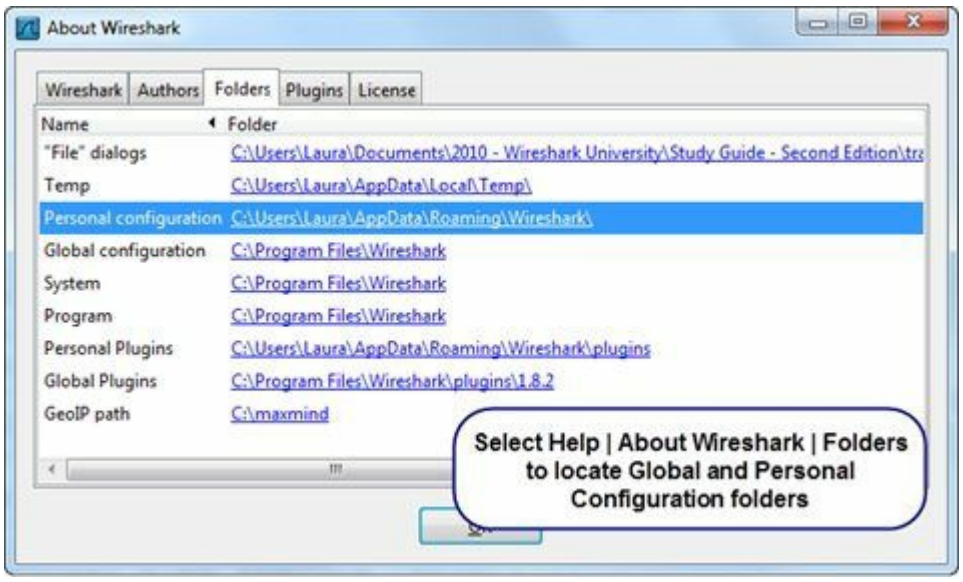
Step 3: Click **OK**. Wireshark now displays your new profile in the Status Bar.

In Lab 6 we worked with some key preference settings (such as *Track number of bytes in flight* and

Calculate conversation timestamps) in the *Default* profile. Since your new profile is based on the *Default* profile, these preference settings are also set in your *wireshark101* profile.

Wireshark remembers the last profile used when it is restarted. To change to another profile, click on

the **Profile** area of the Status Bar and select another profile.



1.6. Locate Key Wireshark Configuration

Files

Wireshark configuration settings are stored in two places: the global configuration directory and the

personal configuration directories. Learning where Wireshark stores settings enables you to quickly

alter settings or share individual configurations with other people or other Wireshark systems.

The location of these directories may be different based on the operating system on which Wireshark

is installed. Select **Help | About Wireshark | Folders** to locate these directories on your system, as

shown in Figure 35.

*Figure 35. Use **Help | About Wireshark | Folders** to find your configuration files.*

Your Global Configuration Directory

The global configuration directory contains the default configuration for Wireshark. When you create

a new profile (without copying an existing profile), Wireshark pulls the basic settings from the files in

the global configuration directory.

The following lists some of the files that may be found in your configuration directories:

preferences contains the settings defined when you select **Edit | Preferences**; this includes name

resolution settings, Filter Expression button settings, and protocol settings.

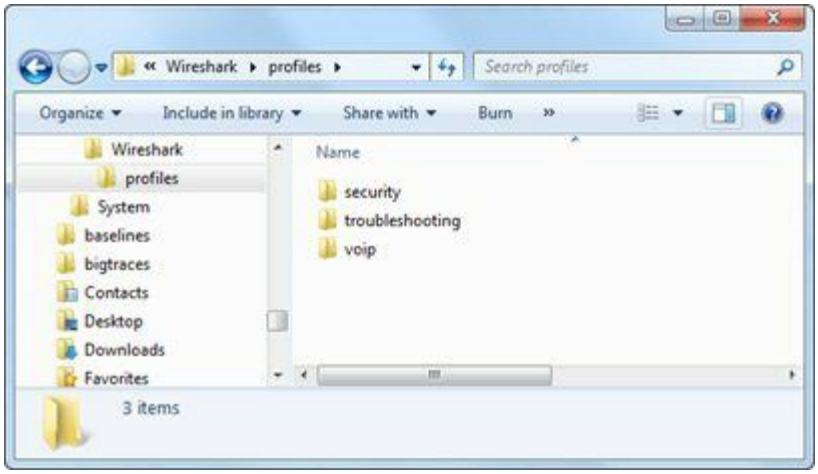
dfilters contains the display filters for a profile.

cfilters contains the capture filters for a profile.

colorfilters contains the coloring rules for a profile.

recent contains miscellaneous settings such as column widths, zoom level, toolbar visibility, and

the recent directory used for loading trace files.



Your Personal Configuration (and *profiles*) Directory

When you make changes to the *Default* profile or create and customize other profiles, Wireshark

stores those changes in your personal configuration directories.

The configuration files for any customized settings made to the *Default* profile reside directly in your

personal configuration directory. When you build your first custom profile, Wireshark creates a

profiles directory in your personal configuration directory.

Inside that *profiles* directory, you will see one directory for each of your custom profiles. Figure 36

shows the directory structure of a Wireshark system that has three profiles named *security*,

troubleshooting, and *voip*.

Figure 36. Custom profiles (and their configuration files) are stored under the profiles directory.

Don't be afraid to edit the configuration files. They are just text files that can be altered in a

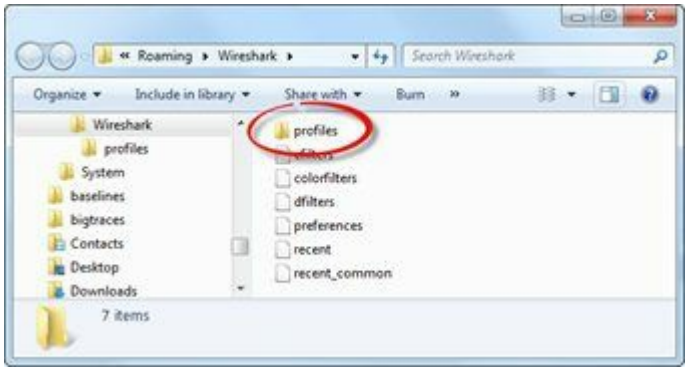
text editor. Now that we've addressed that issue, notice that if you open up the colorfilters file

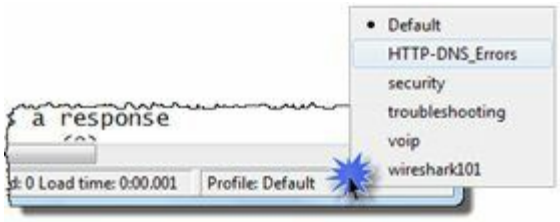
in a text editor such as Notepad, you will see a message that reads, "# DO NOT EDIT THIS

FILE! It was created by Wireshark" at the top of the file. Disregard that message—there is no

reason to avoid editing this file in a text editor. Manual changes will be visible when you

reload the profile.





Lab 8: Import a DNS/HTTP Errors Profile

Once you've created that fabulous profile that detects various types of HTTP or DNS problems

perhaps, consider installing that profile on your other Wireshark systems. Since Wireshark bases

profiles on text files, this is a simple process.

Step 1: Visit ***www.wiresharkbook.com*** and download the sample profile (***httpdnsprofile.zip***). This new profile's directory and contents are zipped into a single file.

Step 2: Select **Help | About Wireshark | Folders**. Double-click on your personal configuration folder to examine the directory structure.

Step 3: As mentioned earlier, Wireshark creates a *profiles* directory when you build your first custom profile (as you did in Lab 7). If you do not see a *profiles* directory at this point, you can manually

create one or return to and complete Lab 7. Open the ***profiles*** directory.

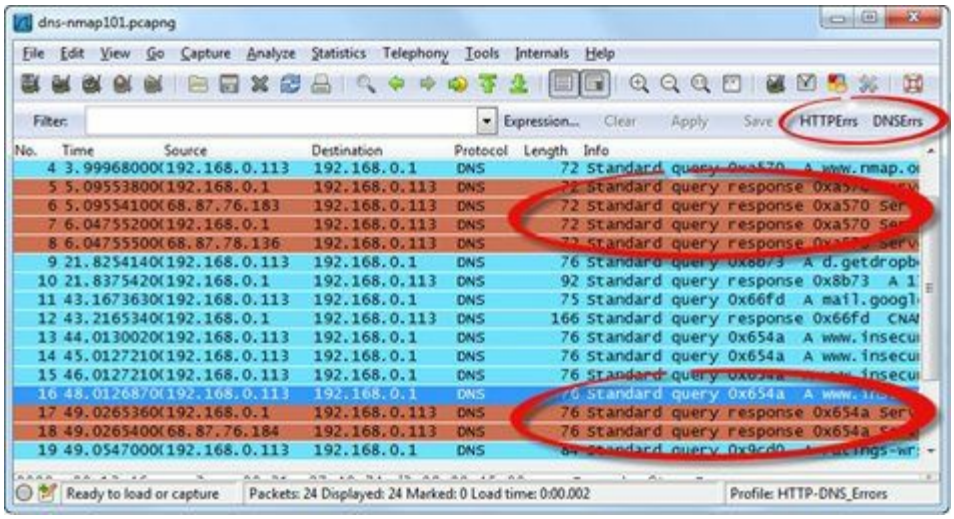
Step 4: Extract the ***httpdnsprofile.zip*** file into this *profiles* directory and extract the file to this location. You should see a new directory called *HTTP-DNS_Errors*. Look inside this new directory to

see the Wireshark configuration files included in this profile.

Step 5: Return to Wireshark and click on the **Profile** column on the Status Bar. You should see the

new profile listed. Click on the ***HTTP-DNS_Errors*** profile to examine this new profile.

Step 6: Open ***dns-nmap101.pcapng*** while working in your *HTTP-DNS_Errors* profile. You should see some interesting colors in the trace file and two new buttons in the display filter area.


dns-nmap101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save HTTPErrs DNSErrs
No. Time Source Destination Protocol Length Info
4 3.99968000(192.168.0.113 192.168.0.1 DNS 72 Standard query
5 5.09553800(192.168.0.1 192.168.0.113 DNS 72 Standard query response
6 5.09554100(68.87.76.183 192.168.0.113 DNS 72 Standard query response 0xa570
7 6.04755200(192.168.0.1 192.168.0.113 DNS 72 Standard query response 0xa570
8 6.04755500(68.87.78.136 192.168.0.113 DNS 72 Standard query response
9 21.8254140(192.168.0.113 192.168.0.1 DNS 76 Standard query 0x8b73 A d.getdropb
10 21.8375420(192.168.0.1 192.168.0.113 DNS 92 Standard query response 0x8b73 A 1
11 43.1673630(192.168.0.113 192.168.0.1 DNS 75 Standard query 0x66fd A mail.googl
12 43.2165340(192.168.0.1 192.168.0.113 DNS 166 Standard query response 0x66fd CNA
13 44.0130020(192.168.0.113 192.168.0.1 DNS 76 Standard query 0x654a A www.insecu
14 45.0127210(192.168.0.113 192.168.0.1 DNS 76 Standard query 0x654a A www.insecu
15 46.0127210(192.168.0.113 192.168.0.1 DNS 76 Standard query
16 48.01268700(192.168.0.113 192.168.0.1 DNS 76 Standard query 0x654a A www.ins
17 49.0265360(192.168.0.1 192.168.0.113 DNS 76 Standard query response 0x654a Ser
18 49.0265400(68.87.76.184 192.168.0.113 DNS 76 Standard query response 0x654a
19 49.0547000(192.168.0.113 192.168.0.1 DNS 84 Standard query
Ready to load or capture
Packets: 24 Displayed: 24 Marked: 0 Load time: 0:00.002
Profile: HTTP-DNS_Errors

TIP

Step 7: Lab Clean-up Click the **Profile** column on the Status Bar and select your ***wireshark101***

profile. You will continue to enhance the *wireshark101* profile in upcoming chapters of this book.

Since profiles are simply a collection of configuration text files, it is easy to move single elements of

a profile (or entire profiles) to other machines.

Some configuration text files, such as the recent configuration file, contain directory paths.

This may generate Wireshark startup errors when you move these types of configuration files

to another system that does not have the same directory paths in place. You could either

avoid moving these files to another system or edit the recent configuration file to match the

directory structure of the target system.

1.7. Configure Time Columns to Spot

Latency Problems

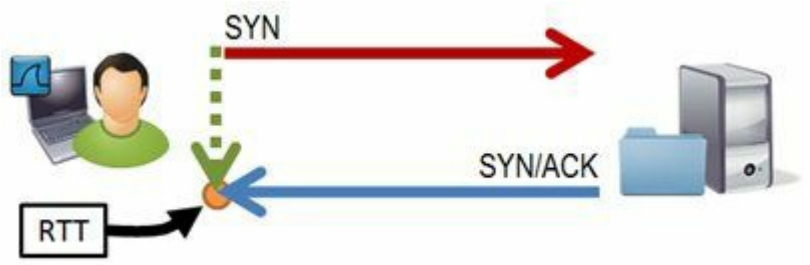
Latency is a measurement used to define time delay. As a host sends a request and waits for a reply,

there is always some latency. Excessive latency can be caused by problems along a path or at the

endpoints.

The **Time** column and **Info** column can be used to detect three specific types of latency—path latency, client latency, and server

latency.



The Indications and Causes of Path Latency

Path latency is often referred to as round trip time (RTT) latency because we often measure how long

it takes for some packet to be transmitted and the response to be received. Using this measurement

process, we can't tell if slow performance is in the outbound or the inbound direction. We just know it

is slow somewhere along the path between two devices.

Path latency can be caused by an infrastructure device, such as an enterprise router, that is prioritizing

(quality of service) traffic. If your low-priority traffic arrives at such a device when high-priority

traffic is flowing through, your lowly traffic may be queued for a bit while the mucky-mucks go flying

through.

Path latency and packet loss can also be caused when there is a bandwidth bottleneck on a network.

For example, if you connect two heavily-loaded gigabit networks together with a 10 Mbps link, it's

like connecting two fire hoses together with a garden hose[18].

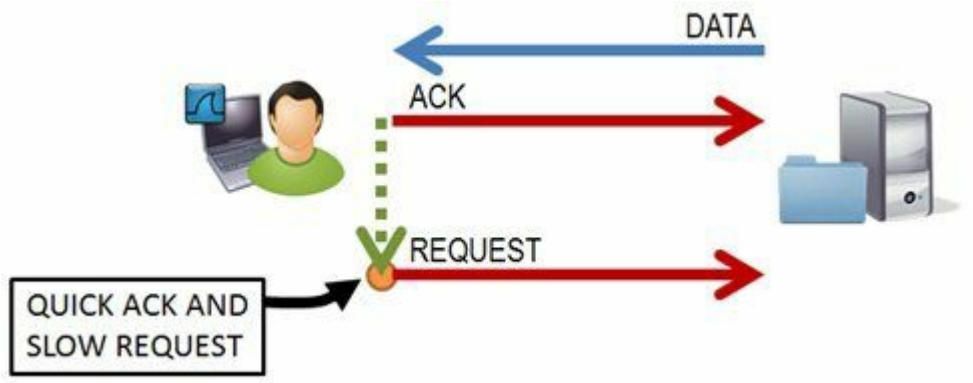
On Wireshark, we can see path latency by looking at the first two packets of a simple TCP three-way

handshake, as shown in Figure 37. Capture close to the client and watch the client send a SYN packet

to the server. How much time goes by before the SYN-ACK? We will look at a trace file that has high

path latency in this section.

Figure 37. Identify path latency by looking at the round trip time (RTT) between the SYN and SYN/ACK of a TCP three-way handshake.



The Indications and Causes of Client Latency

High client latency can be caused by users, applications or a lack of sufficient resources. There is the

natural "human-induced" latency (when you wait for a user to click on something on their screen), but

there's not much we can do about that. We are looking for client latency problems caused by sluggish

client applications.

Of the three latency problems mentioned (path, client and server latency), this is the one that is seen

least often. Most applications put the load on the server side of the communications. If, however, you

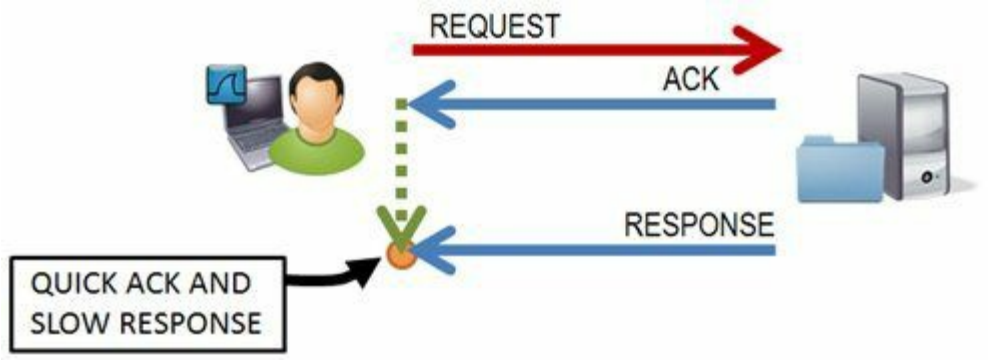
happen to have an application that balances the work load between the client and the server, then we

have to consider the client response times.

In Wireshark, client latency is indicated when we see a large delay before a packet from the client

(ignoring delays due to user interactions), as shown in Figure 38.

Figure 38. Watch for delays before client requests, but don't worry about delays while we wait for a user to enter something on their keyboard.



The Indications and Causes of Server Latency

Server latency occurs when a server is slow replying to incoming requests. This could be caused by a

lack of processing power at the server, a faulty (or poorly written) application, the requirement to

consult another server to get the response information (multi-tiered or middleware architecture), or

some other type of interference delaying the server responses.

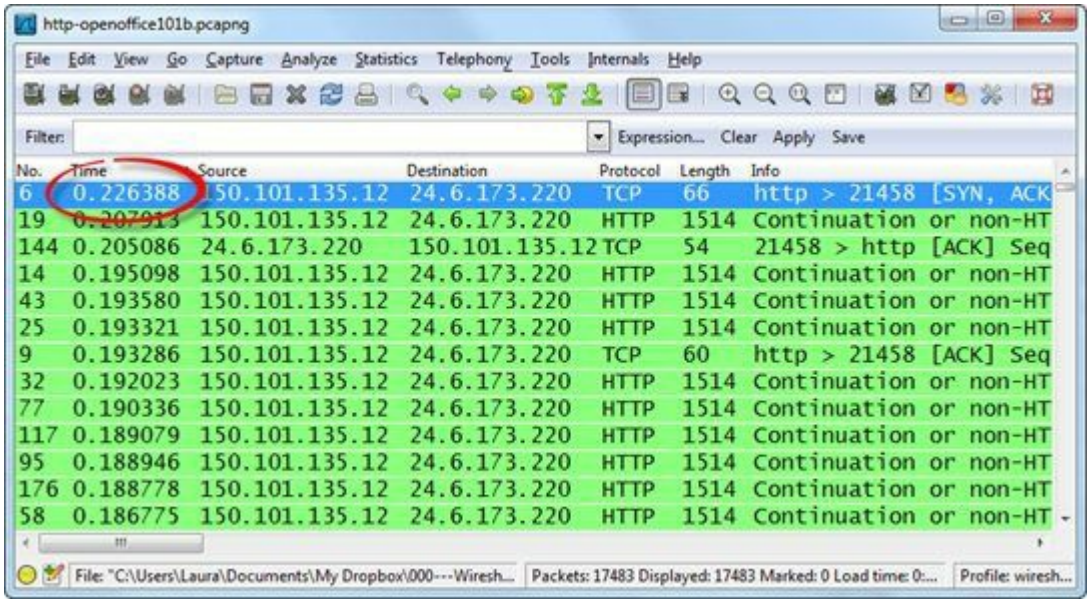
On Wireshark, we can identify server latency by watching a client request heading to the server, a

quick acknowledgment from the server, and then a significant wait time before the requested

information is received, as shown in Figure 39. Sadly, this is becoming more common on networks as

servers are required to support more applications without getting the required upgrades.

Figure 39. Watch for delays between server ACKs and responses.


http-openoffice101b.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
6 0.226388 150.101.135.12 24.6.173.220 TCP 66 http > 21458 [SYN, ACK
19 0.207913 150.101.135.12 24.6.173.220 HTTP 1514 Continuation or non-HT
144 0.205086 24.6.173.220 150.101.135.12 TCP 54 21458 > http [ACK] Seq
14 0.195098 150.101.135.12 24.6.173.220 HTTP 1514 Continuation or non-HT
43 0.193580 150.101.135.12 24.6.173.220 HTTP 1514 Continuation or non-HT
25 0.193321 150.101.135.12 24.6.173.220 HTTP 1514 Continuation or non-HT
9 0.193286 150.101.135.12 24.6.173.220 TCP 60 http > 21458 [ACK] Seq
32 0.192023 150.101.135.12 24.6.173.220 HTTP 1514 Continuation or non-HT
77 0.190336 150.101.135.12 24.6.173.220 HTTP 1514 Continuation or non-HT
117 0.189079 150.101.135.12 24.6.173.220 HTTP 1514 Continuation or non-HT
95 0.188946 150.101.135.12 24.6.173.220 HTTP 1514 Continuation or non-HT
176 0.188778 150.101.135.12 24.6.173.220 HTTP 1514 Continuation or non-HT
58 0.186775 150.101.135.12 24.6.173.220 HTTP 1514 Continuation or non-HT
File: "C:\Users\Laura\Documents\My Dropbox\000---Wiresh...
Packets: 17483 Displayed: 17483 Marked: 0 Load time: 0:...
Profile: wiresh...

Detect Latency Problems by Changing the Time Column Setting

The default **Time** column setting is *Seconds Since Beginning of Capture*. In essence, Wireshark marks the first packet's arrival as 0.000000000. The **Time** column value for each packet after the first one is

based on how much later it arrived during the capture process.

To spot high delta times (the time from the end of one packet to the end of the next packet), select

View | Time Display Format | Seconds Since Previous Displayed Packet. This setting will be

retained with the profile in which you are working.

After changing this setting, click the **Time** column twice to sort from high to low to look for large

delays in the trace file.

In Figure 40, we opened *http-openoffice101b.pcapng*, set the **Time** column to *Seconds Since Previous Displayed Packet*, and sorted the **Time** column from high to low. The first packet that appears is a SYN/ACK—the second packet of the TCP handshake. This trace file was taken at the client and this is

a perfect indication of path latency.

In essence, this delay before the SYN/ACK packet indicates it took almost 1/4 of a second (.226388

seconds) to get to the HTTP server and back. You might as well walk there! [19]

*Figure 40. Sort the **Time** column after setting it to Seconds Since Previously Displayed Packet. [http–openoffice101b.pcapng]*

This method is great when you have a single conversation in the trace file, but if you have numerous

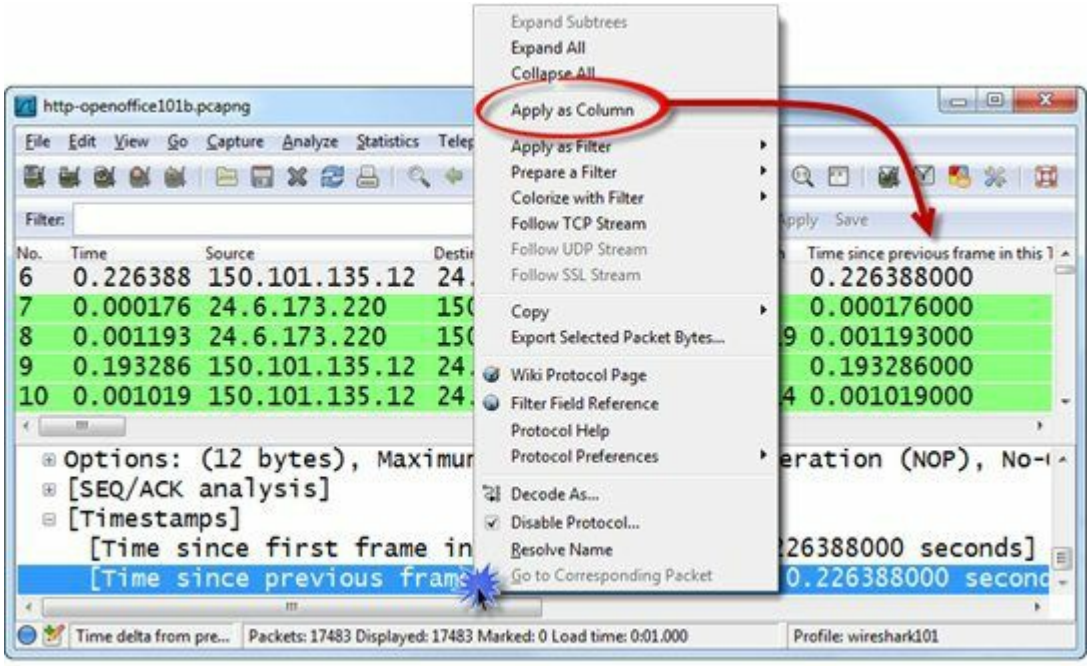
UDP/TCP conversations, the *Seconds Since Previous Displayed Packet* setting can hide problems.

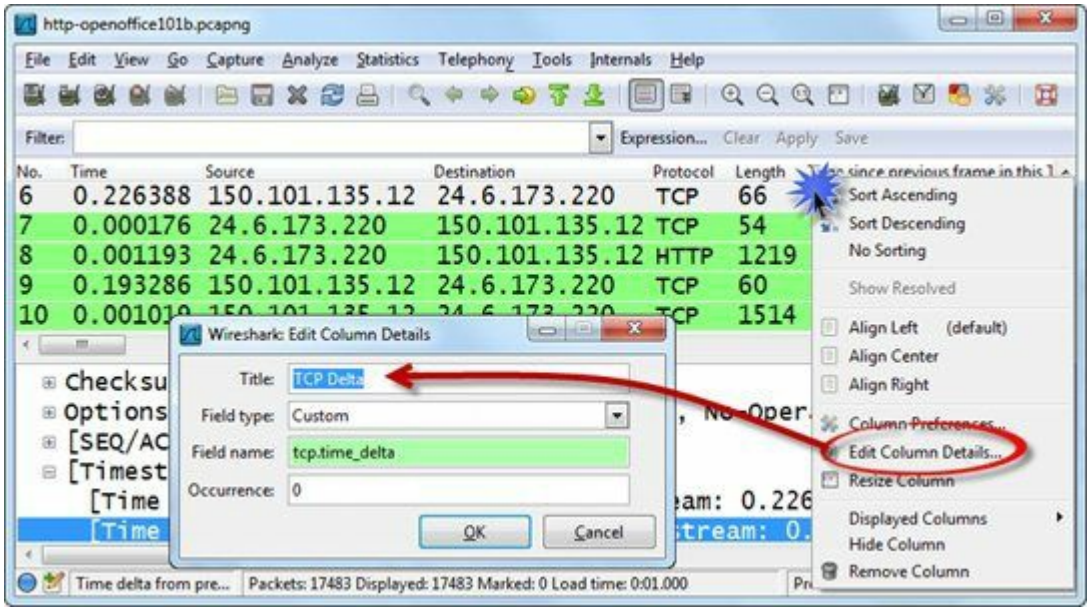
For example, consider what this column would display if you had five different conversations

intertwined in the trace file. The **Time** column is now measuring the delta time between each of the

packets with no regard to the fact that there are five different intertwined conversations. We would

want to see delays inside the separate conversations.





Detect Latency Problems with a New TCP Delta Column

In Lab 6, you enabled the *Calculate conversation timestamps* TCP preference in the *Default* profile by selecting **Edit | Preferences | (+) Protocols | TCP**. In Lab 7, you created your *wireshark101* profile based on the *Default* profile so you should already have this setting in place. Now we will look at how

we can create a column based on that preference setting so we can obtain separate delta time values

for each conversation.

To add a column for the TCP delta time value, expand a TCP header. Right-click on the **Time since**

previous frame in this TCP stream and select **Apply as Column**, as shown in Figure 41. You now

have a new column in the Packet List pane.

*Figure 41. Enable **Calculate conversation timestamps** and add a new column to spot delays inside individual TCP*

conversations. [http–openoffice101b.pcapng]

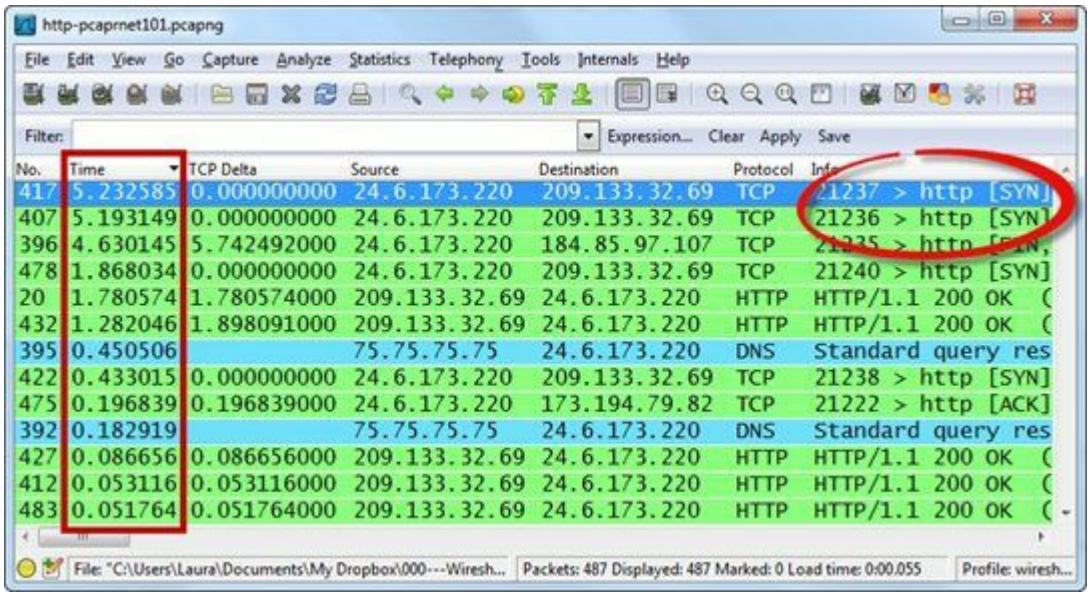
This new column name is too long. To rename a column, right-click the column heading and select

Edit Column Details. Type the new column name in the Title field and click **OK** to save the new

name. In Figure 42, we named our new column **TCP Delta**.

*Figure 42. Right-click on a column heading and choose **Edit Column Details** to change the column name. [http–*

openoffice101b.pcapng]



Let's examine the difference between the **Time** column value and the **TCP Delta** column in a new

trace file.

In Figure 43, we opened *http-pcaprnet101.pcapng*, clicked on, and dragged the new **TCP Delta**

column to the right of the existing **Time** column. We sorted on the **Time** column from high to low to

see the difference in time values between the **Time** column and **TCP Delta** column.

Figure 43. SYN packets show up as high latency in this trace file, but these are false positives [http–pcaprnet101.pcapng]

Before we sort on the **TCP Delta** column to find delays inside individual TCP conversations, let's

consider why some delays can be considered normal.

Don't Get Fooled—Some Delays are Normal

We can see several large delays at the top of the list. In our browsing session to *pcapr.net*, these

delays downloading images are not even noticed by the user. Just like the loading of an .ico file

(which appears as an icon on the browser tab) would not be noticed.

Don't focus on the following packet types. It's not unusual to have delays preceding these packets.

.ico file requests are eventually launched by the browser to put an icon on your browser tab.

SYN packets are sent to establish a new connection with a TCP peer. You may begin capturing

and then ask a user to connect to a web server. There will be a delay before the first packet of the

TCP connection (the SYN packet).

FIN, FIN/ACK, RST, or RST/ACK packets are sent to either implicitly or explicitly terminate

a connection. Browsers send these packets when you click on another tab or when there has been

no recent activity to a site or when the browsing session is configured to automatically close after

a page has loaded. Users do not notice these delays.

GET requests can be generated when a user clicks on a link to request the next page. Other

times, some GET requests may be launched by background processes that have no priority

whatsoever (such as in the .ico file GET requests).

DNS queries may be sent at various times during a web browsing session, such as when a page

that has numerous hyperlinks loads at the client.

TLSv1 encrypted alerts are often seen just before a connection close process (TCP Resets).

Although encrypted, the alert is likely a TLS Close request.

In Figure 44, we are still working in *http-pcaprnet101.pcapng*. Previously, we sorted based on the

Time column. Now, when we sort the **TCP Delta** column from high to low we notice the 18 second

delay before the three background graphics are requested. That common delay is typical of a

background process. The FIN/ACK packets are never a concern as they happen transparently in the

background to time out a TCP connection.

The OK responses in frame 20 and 432[20], however, are a very real concern. This is high server latency. In this trace file, there are delays of 1.898091 seconds and 1.780574 seconds that are worth

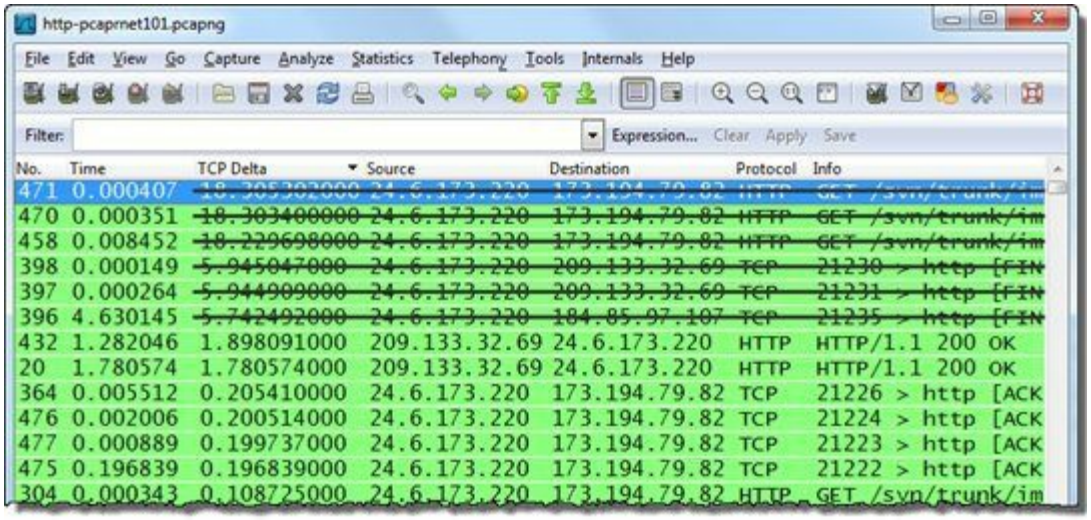
looking into. We don't expect such large delays before the server sends the required web page element.

The server is either overloaded, it doesn't hold the information locally, or perhaps the requested

element is located in a database that needs to be queried before responding.

In this situation, the latter is the case. When you load the *pcapr.net* web site and type in a protocol or application name, that value is used to search a database for entries that match your query.

Also see *Use Filters to Spot Communication Delays*.



TIP

*Figure 44. Sort your **TCP Delta** column from high to low when looking for delays in individual TCP conversations. [http–*

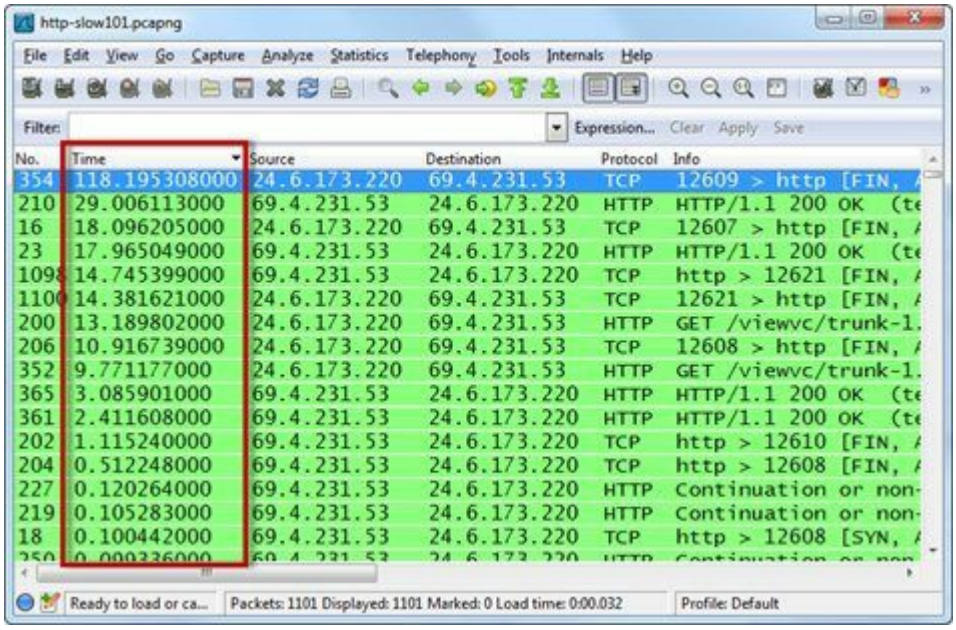
pcaprnet101.pcapng]

When you approach a complaint that the network is slow, always look at the latency times to see if

that is part of the problem. If an application runs over TCP, we can detect path and server latency by

looking at the delay between the SYN and the SYN/ACK (path latency) and the delay between an ACK

from the server (acknowledging a request from a client) and the actual data that follows.



Lab 9: Spot Path and Server Latency Problems

Let's practice using these two columns to detect latency. In this lab you will set the **Time** column to

Seconds Since Previous Displayed Packet and add the **TCP Delta** column.

You may have some of these columns set already if you followed along with the previous section.

Step 1: Open ***http-slow101.pcapng***.

Step 2: Right-click the **Length** column heading and select **Hide Column**. This provides more room for your new column.

Step 3: Select **View | Time Display Format | Seconds Since Previous Displayed Packet**. Click on

your **Time** column heading twice to sort from high to low. Scroll to the top of the list. We can see

some very high delays in this trace file.

Now let's see what happens when we add and work with a column that depicts TCP conversation

timestamps.

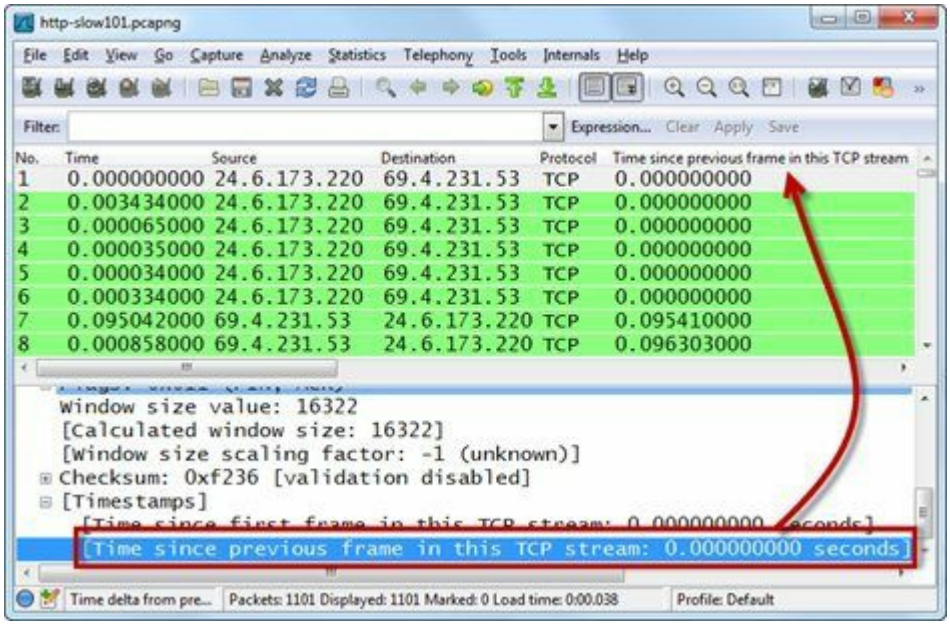
Step 4: Click on the **No.** (Number) column heading to return the trace file to its default sort order.

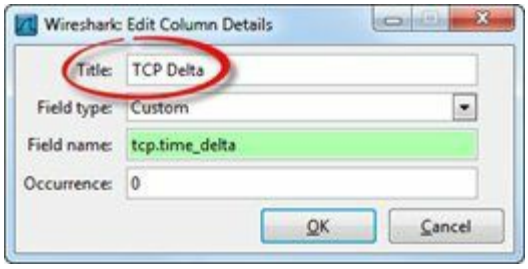
Scroll up or click the **Go To the First Packet** button on the main toolbar to go to **frame 1**.

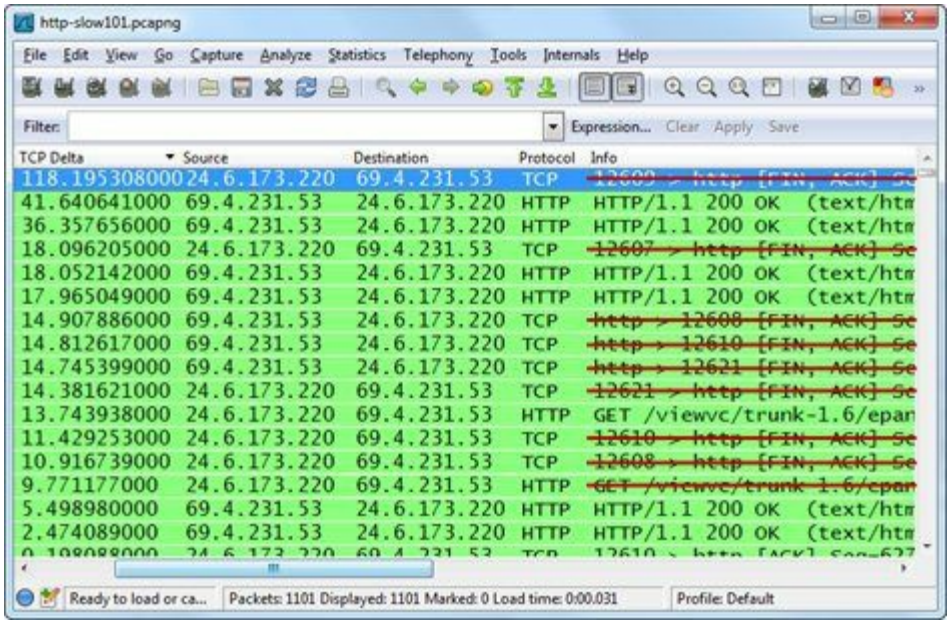
Step 5: Right-click the **TCP header** in the Packet Details pane of frame 1 and select **Expand**

Subtrees. Scroll down and right-click on the **Time since previous frame in this TCP stream** and

select **Apply as Column**. You now have a new column in the Packet List pane, as shown below.


http-slow101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Time since previous frame in this TCP stream
1 0.000000000 24.6.173.220 69.4.231.53 TCP 0.000000000
2 0.003434000 24.6.173.220 69.4.231.53 TCP 0.000000000
3 0.000065000 24.6.173.220 69.4.231.53 TCP 0.000000000
4 0.000035000 24.6.173.220 69.4.231.53 TCP 0.000000000
5 0.000034000 24.6.173.220 69.4.231.53 TCP 0.000000000
6 0.000334000 24.6.173.220 69.4.231.53 TCP 0.000000000
7 0.095042000 69.4.231.53 24.6.173.220 TCP 0.095410000
8 0.000858000 69.4.231.53 24.6.173.220 TCP 0.096303000
Window size value: 16322
[Calculated window size: 16322]
[Window size scaling factor: -1 (unknown)]
Checksum: 0xf236 [validation disabled]
[Timestamps]
[Time since previous frame in this TCP stream: 0.000000000 seconds]
Time delta from pre...
Packets: 1101 Displayed: 1101 Marked: 0 Load time: 0:00.038
Profile: Default





Step 6: Right-click on the new column and select **Edit Column Details**. Type **TCP Delta** in the Title area and click **OK**.

As we sort on the **TCP Delta** column, keep in mind the types of traffic that can contain "normal

delays" as listed in *Don't Get Fooled—Some Delays are Normal*.

Step 7: Click on your new **TCP Delta** column heading and drag the column to the right of the existing **Time** column. Click twice on your new **TCP Delta** column heading to sort from high to low. Since

there are multiple TCP conversations intertwined in this trace file, this **TCP Delta** column gives an

accurate display of latency times in the trace file.

In the image below, we scrolled to the right to view more of the Info column (our **Time** column is no

longer in view).

Do you see anything in common with the top delays in the traffic? There are several very large delays

before the HTTP server said "OK." You can probably imagine that the user would complain about

terrible performance when browsing to this web site.

Step 8: Lab Clean-up Click once on the **No.** (Number) column heading to sort from low to high. This is the original sorting order of trace files.

Right-click on the **TCP Delta** column heading and select **Hide Column**. If you want to view this

column again later, you can right-click on any column heading and select **Display Columns | TCP**

Delta.

Look at the TCP delta times in your web browsing sessions, network logins, or email traffic. Get a feel

for the round trip latency times from your client to numerous hosts.

Chapter 1 Challenge

Open *challenge101-1.pcapng* and use the techniques covered in this chapter to answer these Challenge

questions. The answer key is located in Appendix A.

Important: This trace file includes an HTTP communication running over a non-standard port

number. Before you can answer these questions, you must force Wireshark to dissect this traffic as

HTTP.

Question 1-1.

In which frame number does the client request the default web page ("/")?

Question 1-2.

What response code does the server send in frame 17?

Question 1-3.

What is the largest TCP delta value seen in this trace file?

Question 1-4.

How many SYN packets arrived after at least a 1 second delay?

Chapter 2 Skills: Determine the Best

Capture Method and Apply Capture Filters

"Approach networking protocols like you would human conversations. Think of how people talk to

each other, how they act when they want something, how they show gratitude when they get it. Look for

those types of themes in the packets and network traffic will become easier to understand and

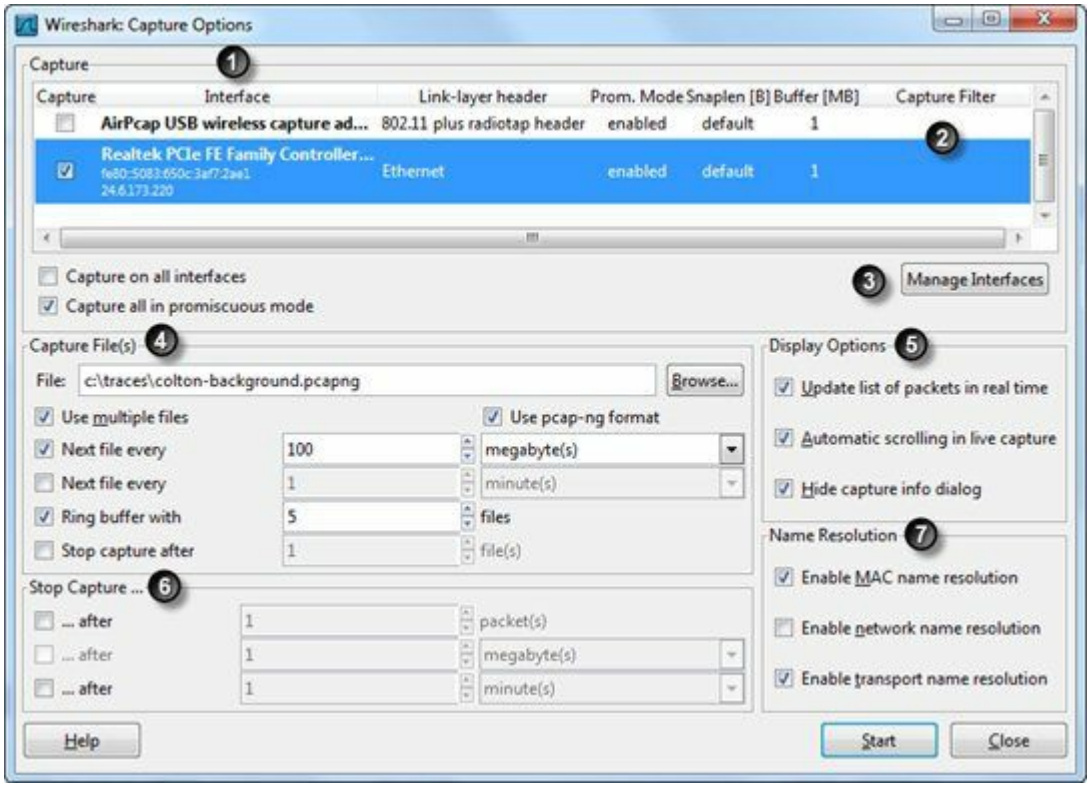
communication nuances will be easier to remember. The time investment is worth it. When you

understand packets, you understand everything in networking."

Betty DuBois

Chief Detective of Network Detectives

and Wireshark University Certified Instructor



Capturing from Realtek PCIe FE Family Controller: \Device\NPF_{6E79FEC0-FF79-4970-96E4-EEFF300A9B9F}
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help

Quick Reference: Capture Options

1. **Interface List**—Select one or more interfaces (multi-adapter capture)

2. **Capture Filter**—Displays applied capture filter (double-click to change, remove or add a capture

filter)

3. **Manage Interfaces**—Click here to add new local/remote interfaces

4. **Capture File(s)**—Save to multiple files, set a ring buffer, and set an auto-stop condition based on

number of files

5. **Display Options**—Set auto-scroll and view packets while capturing

6. **Stop Capture**—Set an auto-stop condition based on number of packets, quantity of data

captured, or elapsed time

7. **Name Resolution**—Enable/disable name resolution for MAC addresses, IP addresses, and ports

8. **Green Wireshark Icon**—Appears during live capture (blue icon otherwise)

2.1. Identify the Best Capture Location to

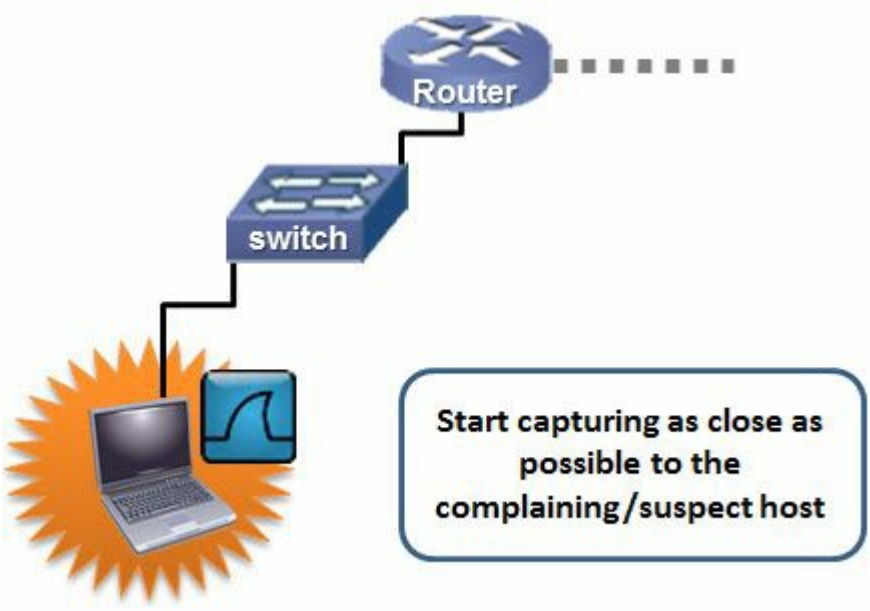
Troubleshoot Slow Browsing or File

Downloads

The first step in analyzing network performance problems is to capture traffic in the right spot. Place

Wireshark in the wrong spot and you may be spending too much time dealing with unrelated traffic or

following a "false positive" for hours.



The Ideal Starting Point

Begin by capturing traffic at or near the host that is experiencing a performance problem, as depicted

in Figure 45. This allows you to see traffic from that host's perspective. You can detect the round trip

latency times, packet loss, error responses, and other problems that the host is experiencing. If a user

complains about slow email downloads, you want to see the performance problems from their

perspective. If you capture somewhere in the middle of the network, your packet capture tool may be

upstream from the point where performance issues are injected into the communications.

Figure 45. You can see the concerns from this host's perspective when you start capturing as close to this host as possible.

TIP

Move if Necessary

After getting a general idea of what is happening from the complaining host's perspective, you may

have to move your packet capture tool to another location to get a different perspective. For example,

if packet loss seems to be the cause of poor performance, you'll want to move Wireshark (or set up a

second Wireshark system) on the other side of the switches or routers to determine where the packets

are being dumped. Most packet loss occurs at interconnecting devices, so that's where you would

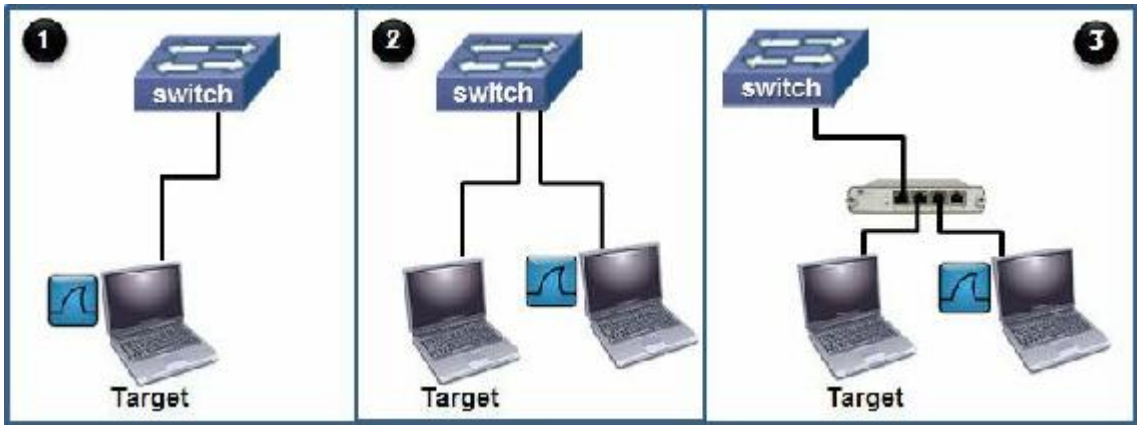
focus.

Start capturing at the client system to get that client's perspective. Watch for high round trip

times to a target, indications of packet loss, problems with buffer sizes (zero window condition

—as discussed in Receive Buffer Congestion Indications), and suspicious or unnecessary

background traffic. Many times you won't have to go any further than the client's perspective.



TIP

2.2. Capture Traffic on Your Ethernet

Network

There are lots of ways to capture traffic on your Ethernet network. Knowing your options will help

ensure you use the most efficient method to capture traffic. You have three options for capturing close

to the complaining host. Options 1 through 3 are displayed in Figure 46.

Figure 46. You have three basic options for capturing traffic on an Ethernet network.

Option 1: Capture directly on the complaining host

This may be a great option if you are allowed to install packet capture software on that host. You don't

have to install Wireshark. Consider using a simple packet capture utility such as tcpdump.

Option 2: Span the host's switch port

If the switch above the user supports port spanning and you have rights to configure that switch,

consider setting up that switch to copy all traffic to or from the user's switch port down your

Wireshark port. One concern to note, however, is that switches will not forward link-layer error

packets so you may not see all the traffic related to poor performance.

Option 3: Set up a Test Access Port (TAP)

Taps[21] are full-duplex devices that are installed in the path between the host of interest and the switch. By default, taps forward all network traffic, including link-layer errors. Although taps can be

expensive, they can be a life-saver if you want to listen to all traffic to or from a host.

Prepare and practice your capture process well in advance. You don't want to run around

looking for the switch port spanning configuration information while people are screaming

about network problems. If you are going to use a tap to listen to traffic to/from a server,

consider keeping the tap in place, always ready when you need it.

2.3. Capture Traffic on Your Wireless

Network

Wireshark can help you understand how wireless networks (WLANs) work and also help you find the

cause of lousy performance on your home or work network. You have a few options for capturing on

the WLAN side. First, determine what your native WLAN adapter can see while running Wireshark.

What can Your Native WLAN Adapter See?

Select **Capture | Interfaces** to determine if your wireless adapter is listed and if it sees traffic through Wireshark. If you just see 0 in the **Packets** column or **Packets/s** column, but you know there is WLAN

traffic, your native adapter probably isn't going to work with Wireshark.

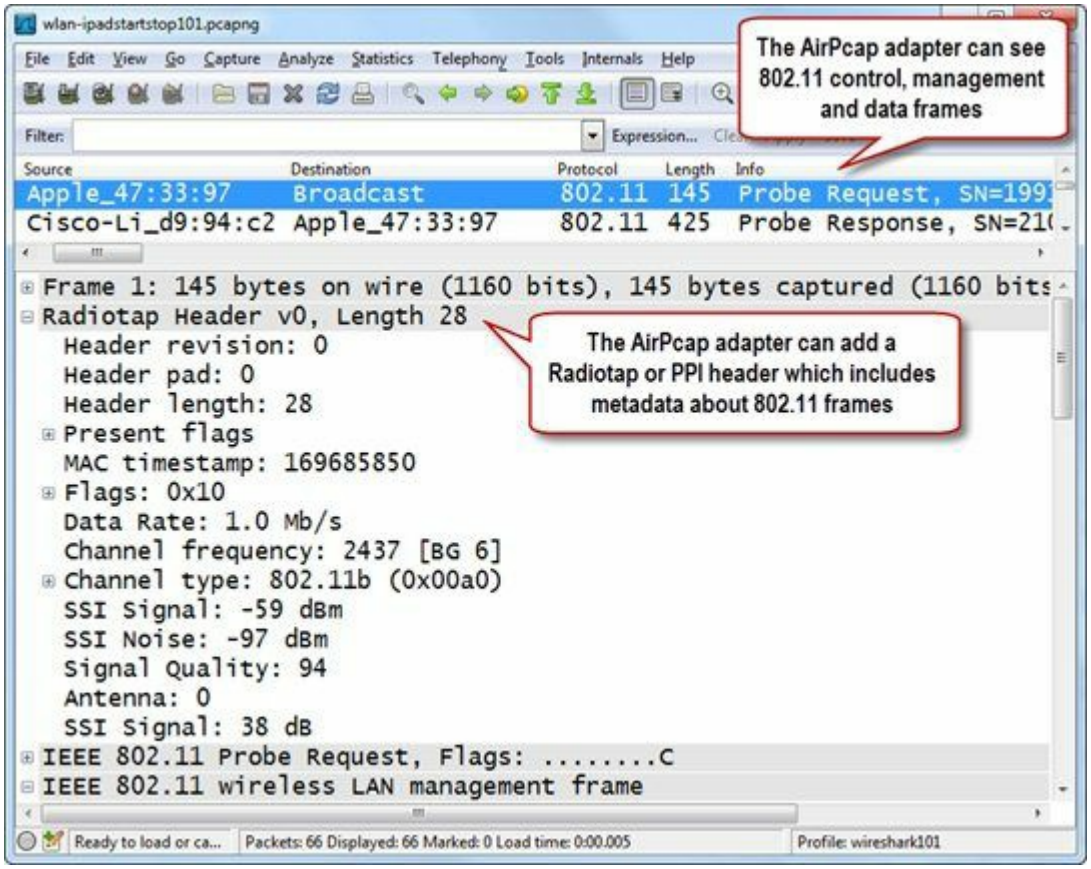
If you do see some packets with your native adapter, select that adapter and click **Start**. If your

adapter can see WLAN beacons as well as data packets and you see 802.11 headers, your adapter

might work as a packet capture interface. However, if the adapter does not add metadata, such as the

signal strength at the time of capture, you are missing out on some important data required for

analysis[22].


wlan-ipadstartstop101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression...
The AirPcap adapter can see 802.11 control, management and data frames
Source Destination Protocol Length Info
Apple_47:33:97 Broadcast 802.11 145 Probe Request, SN=199
Cisco-Li_d9:94:c2 Apple_47:33:97 802.11 425 Probe Response, SN=21
Frame 1: 145 bytes on wire (1160 bits), 145 bytes captured (1160 bits
Radiotap Header v0, Length 28
Header revision: 0
Header pad: 0
Header length: 28
Present flags
MAC timestamp: 169685850
Flags: 0x10
Data Rate: 1.0 Mb/s
Channel frequency: 2437 [BG 6]
Channel type: 802.11b (0x00a0)
SSI Signal: -59 dBm
SSI Noise: -97 dBm
Signal Quality: 94
Antenna: 0
SSI Signal: 38 dB
IEEE 802.11 Probe Request, Flags: C
IEEE 802.11 wireless LAN management frame
The AirPcap adapter can add a Radiotap or PPI header which includes metadata about 802.11 frames
Ready to load or ca...
Packets: 66 Displayed: 66 Marked: 0 Load time: 0:00.005
Profile: wireshark101

TIP

Use an AirPcap Adapter for Full WLAN Visibility

AirPcap adapters are specifically designed to capture all types of WLAN traffic, apply WLAN

decryption keys (if supplied), and add metadata about the captured frames.

AirPcap adapters can capture 802.11 control, management, and data frames. In addition, these

adapters run in monitor mode (also referred to as RF monitor or RFMON mode), which enables the

adapter to capture all traffic without having to associate with a specific Access Point. This means the

AirPcap adapter can capture traffic on any 802.11 network, not just the one to which the local host

typically associates itself.

AirPcap adapters can be configured to affix either a PPI (Per-Packet Information) or RadioTap header

to each WLAN frame. These headers contain some great information, such as the frequency on which

the frame arrived, the signal strength and noise level at the moment and location of capture, and more.

Figure 47 depicts a trace file (*wlan–ipadstartstop101.pcapng*) captured with an AirPcap adapter. The

Packet Details pane displays the additional information contained in the RadioTap header.

If you need to capture WLAN traffic, the AirPcap adapters are an excellent option. For more

information on AirPcap adapters, visit www.riverbed.com.

Figure 47. The AirPcap adapter enables you to see control, management, and data frames. In addition, the adapter prepends a Radiotap or PPI header with 802.11 metadata to the frames. [wlan–ipadstartstop101.pcapng]

When troubleshooting or securing WLAN networks, begin as close as possible to the

complaining/suspect host (just like you did when capturing on a wired network).

Try capturing on your native adapter to determine its capabilities. You need to see true 802.11

headers as well as management, data, and control frames. AirPcap adapters are a worthwhile

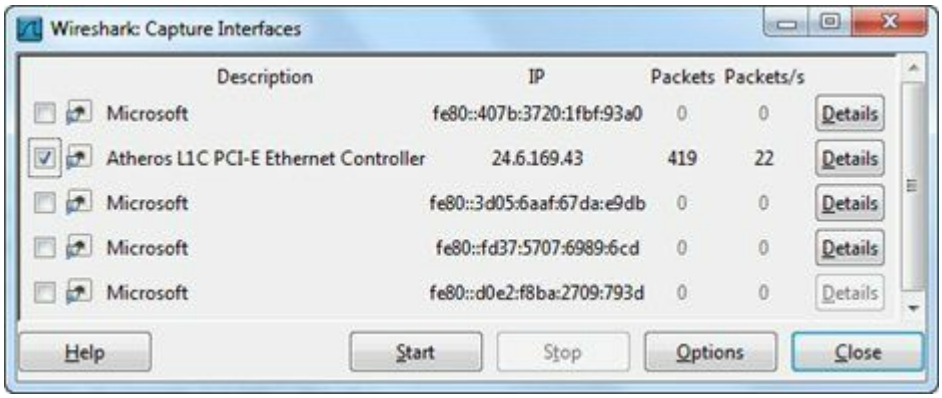
investment if you are going to be analyzing wireless network traffic.

2.4. Identify Active Interfaces

If Wireshark can't see an interface, you can't capture traffic. If you have more than one interface, you

need to determine which one to use. Mastering the interface options is required to be successful as an

analyst.



Determine Which Adapter Sees Traffic

Select **Capture | Interfaces** or click the Interfaces button on the main toolbar to quickly determine

which interface is seeing traffic and to which network each interface is connected.

If you are using a dual-stack host (IPv4 and IPv6), Wireshark shows you the IPv6 address of each

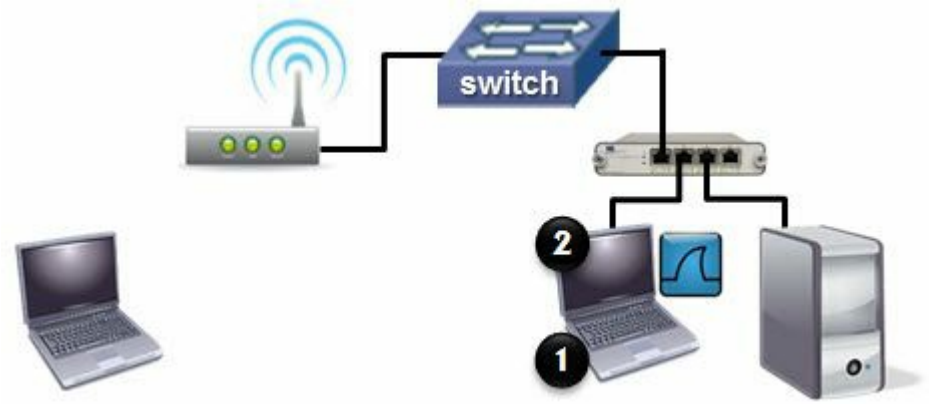
adapter by default. Click on the IPv6 address to see an adapter's IPv4 address, if one exists. For

example, in Figure 48 we clicked on the IPv6 address displayed for the Atheros L1C PCI-E Ethernet

Controller adapter. Wireshark is now displaying the IPv4 address for that adapter.

Figure 48. We can easily tell which interface is able to capture traffic. Click on the address to toggle between IPv4 and IPv6

addresses assigned to that interface.



TIP

Consider Using Multi-Adapter Capture

As of Wireshark 1.8, you can capture on two or more interfaces at a time. This is useful if you want to

capture on the wired and wireless network simultaneously. For example, if you are trying to

troubleshoot a WLAN client on the network, you can capture on the client's WLAN adapter and the

wired network simultaneously, as shown in Figure 49.

Figure 49. You can simultaneously capture a client's traffic as it travels through to wireless and wired networks.

*The **Details** button (not available with Wireshark for MAC OS X unfortunately) provides lots of*

information about the local interfaces. This information is piped up by the interface and may

include details about the interface configuration and capabilities, as well as transmit and

receive statistics.

2.5. Deal with TONS of Traffic

Inside a busy enterprise, the traffic can overload Wireshark[23] leaving you with a corrupt trace file that makes your analysis thoroughly inaccurate. Learn to deal with high rates of traffic to ensure you

can track down problems on any size network.

In Chapter 8 we will look at command-line capture techniques using Tshark and dumpcap.

Why are You Seeing So Much Traffic?

If a user is complaining about slow web browsing, begin capturing traffic and then ask the user to

browse to some web sites. Keep capturing until your user has demonstrated the slow

browsing problem. You will have captured traffic that will help you determine if the performance

problem is linked to the client, server, or path.

When you capture close to the client, you should see much less traffic than if you'd tapped into the

middle of the enterprise. It is likely that Wireshark can keep up with traffic rates to and from the

client.

If you are dealing with a security issue (perhaps you think a host contains malware), you may want to

capture all traffic to or from this host for quite a while. During this capture process, don't let a user

access the keyboard of this machine. You don't want to capture user behavior.

You can get severe back pains from sleeping on the office floor or quickly fill up a hard drive if you

don't set this up as an unattended capture process.

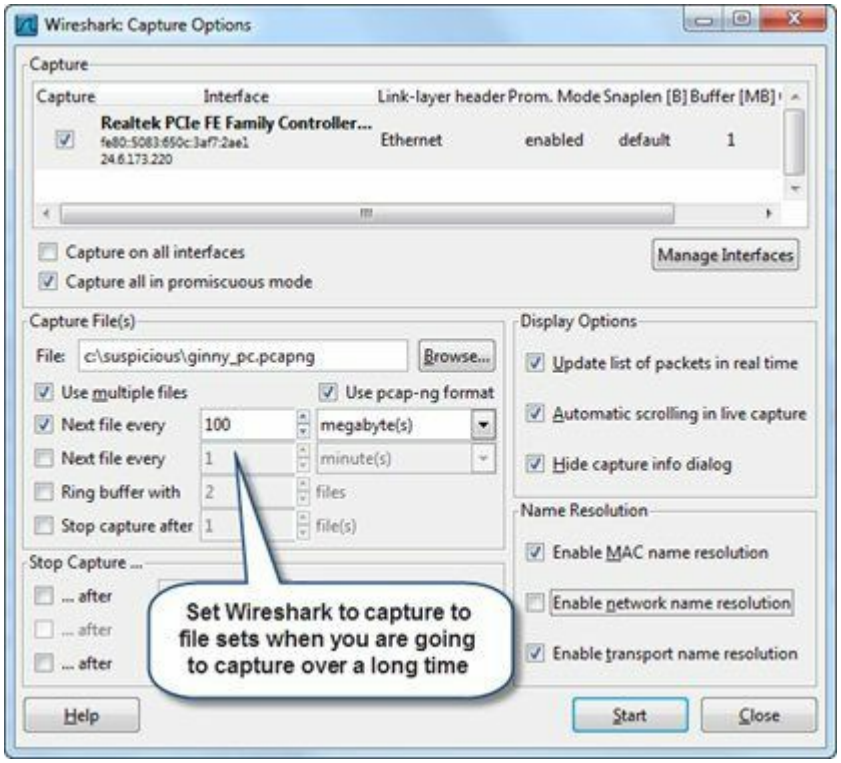
This is the Best Reason to Use Capture Filters

Dealing with too much data is one of the best reasons to use capture filters. By reducing the number of

packets Wireshark must capture, you reduce the load on Wireshark while reducing the amount of

traffic you must wade through. Keep in mind, however, that an overly restrictive capture filter may

cause you to miss key packets. Look at capturing to file sets as a safe option.



Capture to a File Set

Wireshark can capture traffic to file sets. File sets are individually linked files that can be examined

using Wireshark's **File | File Set | List Files** feature.

Select **Capture | Options** and check the box next to the interface on which you want to capture traffic.

Enter the path and file name for the file set in the Capture File(s) section, as shown in Figure 50.

Check **Use multiple files** and define the criteria to create the next file.

In our example, Wireshark will create a set of 100 MB-sized files in .pcapng format. We didn't set a

stop criteria so we'll need to manually stop the capture process at some point.

Figure 50. We set up Wireshark to capture to a set of 100 MB-sized files.

In the example shown in Figure 50 since we suspect malware is running on a host, we will let

Wireshark capture the traffic to and from this host for the next 12 hours to see if there is a phone

home process running in the background. You may need to capture for longer or shorter times,

depending on what you see in the trace file(s).

When Wireshark saves to these file sets, the files will be named *ginny_pc* followed by a file number

and date/time stamp. For example, if we captured three files, they would be named as follows:

ginny_pc_00001_20130123180713.pcapng

ginny_pc_00002_20130123184116.pcapng

ginny_pc_00003_20130123190252.pcapng ...

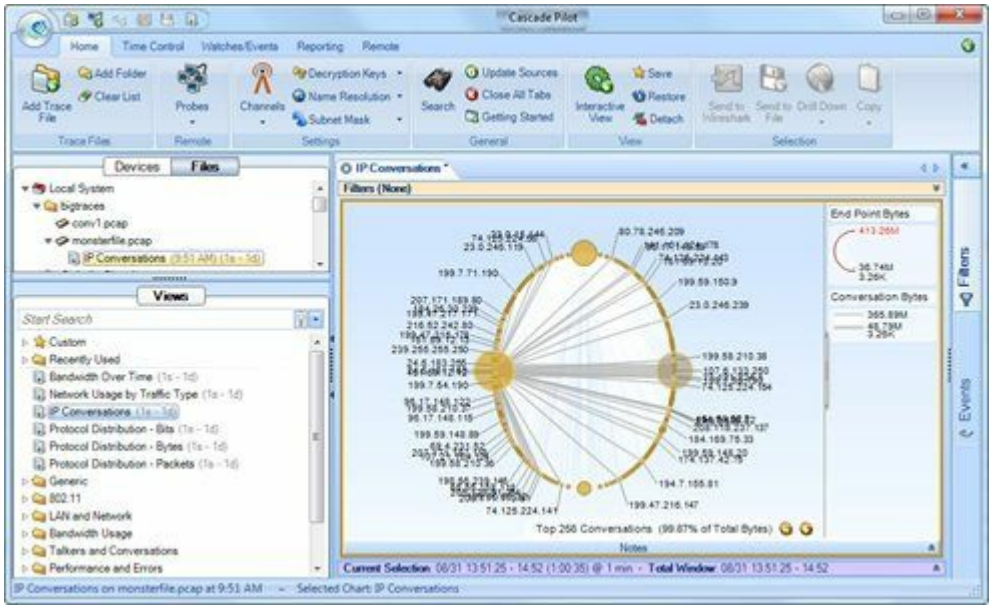
Open and Move around in File Sets

To work with file sets, use **File | Open** and select any of the files in your file set. After opening the

first file from this set, use **File | File Set | List Files** to see all the files in your file set.

Click on the radio button in front of each file to quickly move from one file to another. See also *Use*

Special Capture Techniques to Spot Sporadic Problems.



TIP

Consider a Different Solution—Cascade Pilot®

It was evident back in 2007 that trace files were getting larger and larger as network speeds increased

and file sizes expanded to include multimedia elements. Wireshark suddenly became a cumbersome

tool to use on these files.

In 2009, Loris Degioanni, creator of WinPcap, began work on a product that is now known as Cascade

Pilot[24]. Cascade Pilot handles large trace files, offers graphing and reporting capabilities missing in Wireshark, and integrates tightly so you can export specific packets for closer inspection.

One of Cascade Pilot's most welcome features is the ability to handle larger trace files. For example,

in a recent test, it took 1 minute and 52 seconds to open a 1.3 GB file in Wireshark. Each time we

added a display filter, column, or coloring rule, Wireshark had to reload the file. Wireshark essentially

became unusable. In Cascade Pilot, we loaded the IP conversations view of the same file (shown in

Figure 51) in less than 3 seconds.

Figure 51. The IP Conversations view of our 1.3 GB file loaded in less than 3 seconds in Cascade Pilot.

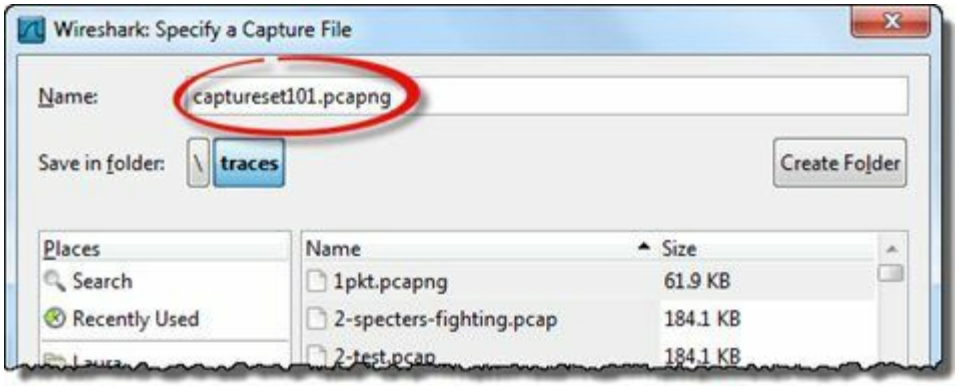
Try to keep your file size below 100 MB. Larger file sizes will cause Wireshark to become

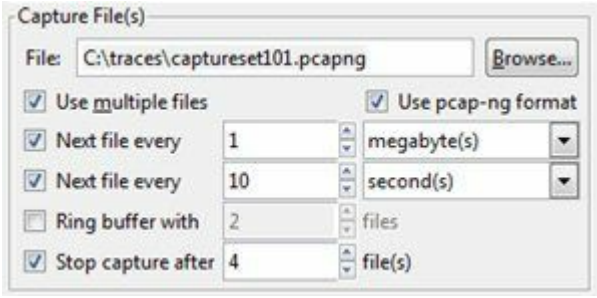
sluggish when you add columns, apply filters, or build graphs. Wireshark is not very good at

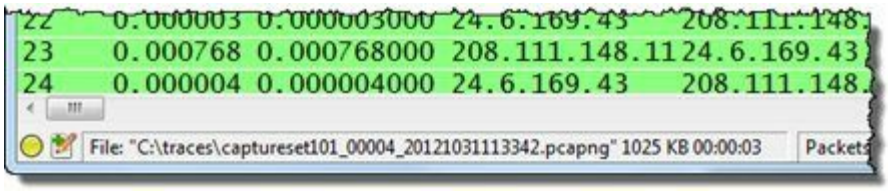
handling huge trace files. Cascade Pilot® was created to work with the larger trace files and to

integrate seamlessly with Wireshark. If you must capture and work with very large trace files

(over 100 MB), look into Cascade Pilot as an analyzer solution.







Lab 10: Capture to File Sets

In this lab you will get a chance to practice capturing to file sets using an auto-stop condition.

Step 1: Click on the **Capture Options** button

on the main toolbar.

Step 2: Click on the checkbox in front of the adapter you are currently using to connect to the Internet.

Step 3: In the Capture File(s) area, click the **Browse** button to navigate to and select the directory in which you want to save your trace files. Enter ***captureset101.pcapng*** in the Name area, as shown

below. Click **OK**.

Step 4: Toggle back to the Capture Options window. Your directory and file name should appear in

the File section. Select **Use multiple Files** and define the next file every **1 MB** and next file every **10**

seconds. Whichever condition is met first causes the creation of the next file. Enter **4** in the Stop capture after area, as shown below.

Step 5: Click **Start**.

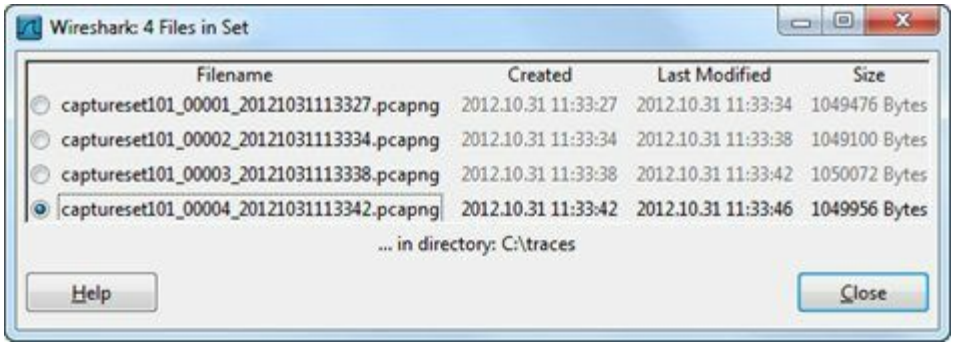
Step 6: Open your browser and visit **www.openoffice.org**. Browse around the web site for at least 40

seconds.

Toggle back to Wireshark and look in the File area of the Status Bar. You should see your file name

stem (*captureset101*) followed by a file number (_ *00004* shown below) and the date and timestamp.

Step 7: Select **File | File Set | List Files**. Wireshark displays all four files of your file set. Click the radio button in front of the various files to move quickly from one file to another.



Step 8: Lab Clean-up Close your File List window. Note that Wireshark retains many of your capture

options. You will need to check the capture option settings when you prepare for the next capture

process.

When you are dealing with a lot of traffic, consider saving to file sets. Wireshark will load the

files faster if they are under 100 MB. You will find yourself using file sets more often as you

need to capture larger amounts of traffic.

2.6. Use Special Capture Techniques to Spot

Sporadic Problems

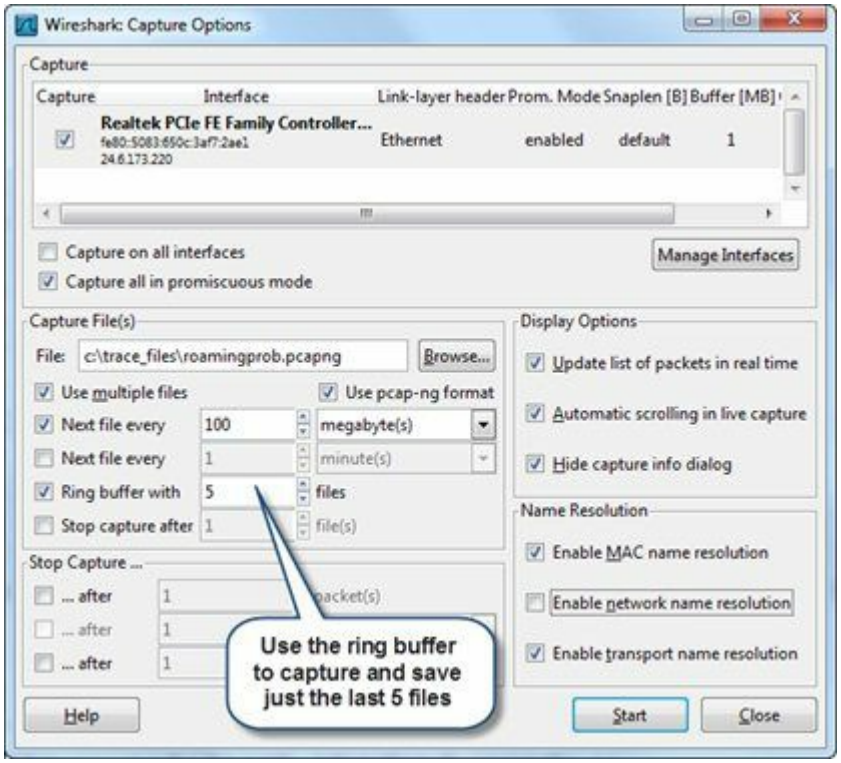
Sporadic, roaming problems often plague analysts. Using a few key Wireshark functions you can be

ready to catch these annoyingly elusive events.

If you have a sporadic problem, one that seems to appear on and off through a network, you will need

to be a bit more creative with your capture process. In this case, you should capture traffic

continuously until the problem occurs again.



Use File Sets and the Ring Buffer

In this situation, set up Wireshark to capture traffic to file sets, but use the ring buffer option. In

Figure 52, we defined a new file name (*roamingprob.pcapng*) and indicated that we want to keep a

total of 5 files (ring buffer setting of 5).

Figure 52. We are going to examine the last 500 MB of traffic leading up to the problem point in time.

When Wireshark finishes capturing the fifth 100 MB file, it will delete the first 100 MB file and

create a sixth 100MB file. Let Wireshark run continuously. The file set feature won't fill up the hard

drive and you will have the last 500 MB leading up to the problem.

Stop When Complaints Arise

When the user complains about performance, stop the capture process manually and look at the most

recent file to see what happened.

Wireshark will keep numbering the files so you know how many 100 MB files have been created and

deleted (if older than the last five files).

For example, we may see file names such as:

roamingprob_00007_20130109203453.pcapng

(created at 8:34:53PM on January 9th, 2013)

roamingprob_00008_20130110023321.pcapng

(created at 2:33:21AM on January 10th, 2013)

roamingprob_00009_20130110091141.pcapng

(created at 9:11:41AM on January 10th, 2013)

roamingprob_00010_20130110094214.pcapng

(created at 9:42:14AM on January 10th, 2013)

roamingprob_00011_20130110100107.pcapng

(created at 10:01:07AM on January 10th, 2013)

This is a great way to let Wireshark automatically capture traffic for later review.

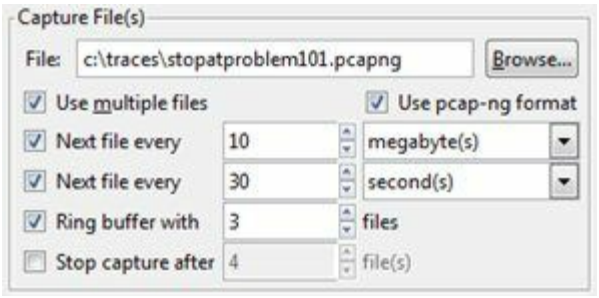
Practice this skill by configuring Wireshark to capture to file sets with a ring buffer as you are

going about your daily work. As Wireshark runs in the background, you are ready to capture

the traffic leading up to any type of problem that arises. For example, if you suddenly notice a

web site loads slower than usual, you can toggle to Wireshark and stop the capture to see

what recently happened.



Lab 11: Use a Ring Buffer to Conserve Drive Space

In this lab exercise, we will set up a ring buffer to ensure we see the most recent traffic. We will

create a problem and manually stop the capture to analyze the issue.

Step 1: Click on the **Capture Options** button

on the main toolbar.

Step 2: Click on the **checkbox** in front of the adapter you are currently using to connect to the

Internet.

Step 3: In the Capture File(s) area, click the **Browse** button to navigate to and select the directory in which you want to save your trace files. Enter ***stopatproblem101.pcapng*** in the Name area. Click **OK**.

Step 4: Toggle back to the Capture Options window. Your directory and file name should appear in

the File section. Select **Use multiple files** and define the next file every **10 MB** and next file every **30**

seconds. Whichever condition is met first causes the creation of the next file. Select the **Ring Buffer** option and enter **3** to define the maximum number of files to keep. Uncheck the **Stop capture after**

setting, as shown below.

Step 5: Click **Start**.

Step 6: Open your browser and visit **www.wireshark.org**. Spend at least 30 seconds browsing around

the site.

Step 7: Now browse to **www.chappellu.com/nothere.html**. This should generate a 404 error because

the file does not exist.

Step 8: Quickly toggle back to Wireshark and click the **Stop Capture** button.

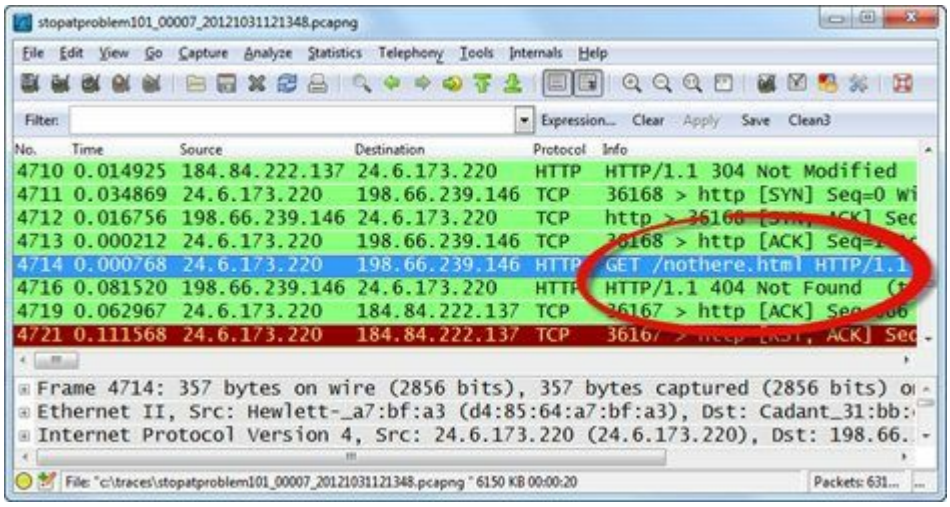
Step 9: Look in the File area of the Status Bar. You can see how many file numbers have been

assigned to this point. When you look at the directory to which you saved files, you only see three

files because your ring buffer was set up to save only the last three files.

Step 10: Click the **Go To Last Packet** button and scroll backwards through the tracefile from the end towards the start to locate the 404 error message from the server, as shown below.

In Lab 19, you will use a display filter to quickly locate 404 error responses.


stopatproblem101_00007_20121031121348.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save Clean3
No. Time Source Destination Protocol Info
4710 0.014925 184.84.222.137 24.6.173.220 HTTP HTTP/1.1 304 Not Modified
4711 0.034869 24.6.173.220 198.66.239.146 TCP 36168 > http [SYN] Seq=0 Wi
4712 0.016756 198.66.239.146 24.6.173.220 TCP
4713 0.000212 24.6.173.220 198.66.239.146 TCP
4714 0.000768 24.6.173.220 198.66.239.146 HTTP GET /nothere.html HTTP/1.1
4716 0.081520 198.66.239.146 24.6.173.220 HTTP HTTP/1.1 404 Not Found
4719 0.062967 24.6.173.220 184.84.222.137 TCP
4721 0.111568 24.6.173.220 184.84.222.137 TCP
Frame 4714: 357 bytes on wire (2856 bits), 357 bytes captured (2856 bits) o
Ethernet II, Src: Hewlett-_a7:bf:a3 (d4:85:64:a7:bf:a3), Dst: Cadant_31:bb:
Internet Protocol Version 4, Src: 24.6.173.220 (24.6.173.220), Dst: 198.66.
File: "c:\traces\stopatproblem101_00007_20121031121348.pcapng" 6150 KB 00:00:20
Packets: 631...

Step 11: Lab Clean-up Note that Wireshark retains many of your capture options. You will need to

check the capture option settings when you prepare for the next capture process.

Using a ring buffer and manual stop process allows you to detect what happened up to and at the time

performance went awry.

2.7. Reduce the Amount of Traffic You have

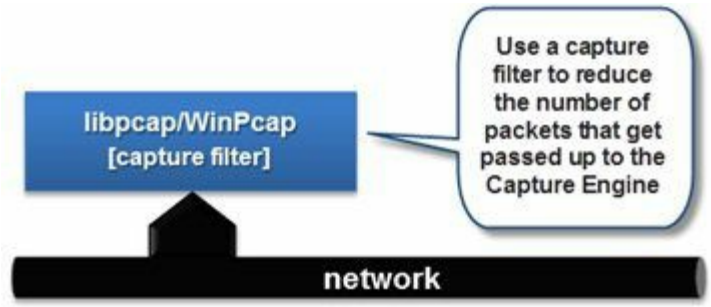
to Work With

Rather than prepare for a week of sifting through packets, consider reducing the work load

significantly by capturing at the proper location and filtering during the capture process.

If you must capture traffic inside the enterprise or on a server that is very busy, you may find that

Wireshark cannot keep up with the traffic rate.


libpcap/WinPcap
[capture filter]
Use a capture filter to reduce the number of packets that get passed up to the Capture Engine
network

Detect When Wireshark Can't Keep Up

Wireshark launches *dumpcap.exe* to capture traffic. Wireshark pulls the traffic from dumpcap. If

dumpcap cannot keep up with the traffic during a capture process (most likely because Wireshark is

not pulling the traffic from dumpcap fast enough), the phrase "Dropped: x" will appear on Wireshark's

Status Bar in the center column.

Most likely, your trace file will contain numerous *ACKed Lost Segment* and *Previous Segment Not*

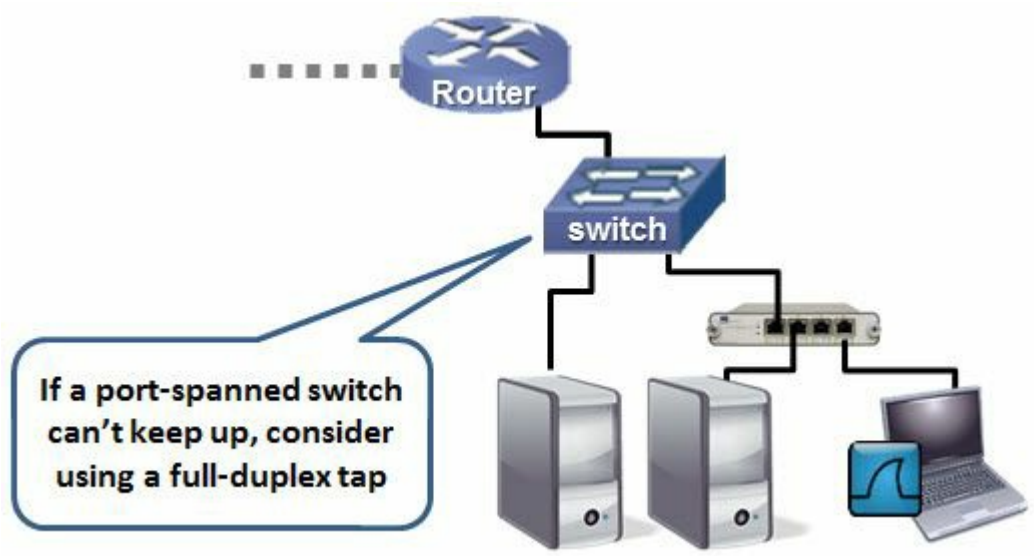
Captured indications. You cannot work with a faulty trace file. Your assumptions and analysis would

be as incomplete as the data from which you worked. Such a trace file is unusable.

This is a perfect time to apply capture filters. [25] Figure 53 shows that capture filters are applied before the packets are sent to the capture engine. By applying capture filters at this point, you have a

better chance of avoiding dropped packets.

Figure 53. Capture filters reduce the load on the Capture Engine.



Detect when a Spanned Switch Can't Keep Up

Packet drops can also occur when you are spanning ports on a very busy switch. Consider what would

happen if you spanned a physical switch port that connects to a very busy network. You connect to the

network on a 1 Gb link (which is actually 2 Gb because of full-duplex operations). If this network is

very busy and you span several switch ports down your lowly 1 Gb downlink, that switch is likely

going to drop some packets. This situation is called oversubscription.

In this case, Wireshark won't note **Dropped: x** in the Status Bar. Instead, you may see numerous

ACKed Lost Segment and *Previous Segment Not Captured* indications. Wireshark doesn't indicate that it has dropped any packets, because it hasn't—the switch didn't forward the packets to Wireshark.

This switch span capture configuration is not going to work. You'll need to change where and how you

capture traffic. A full-duplex tap is a great solution in this case, as shown in Figure 54. Intelligent taps

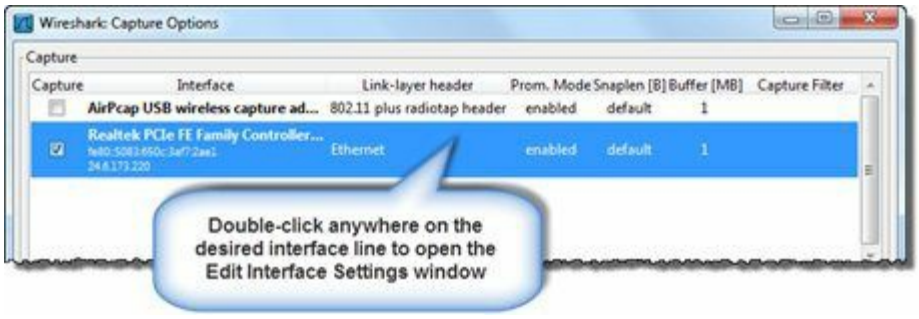
can even offer some capture filtering capability at the tap.

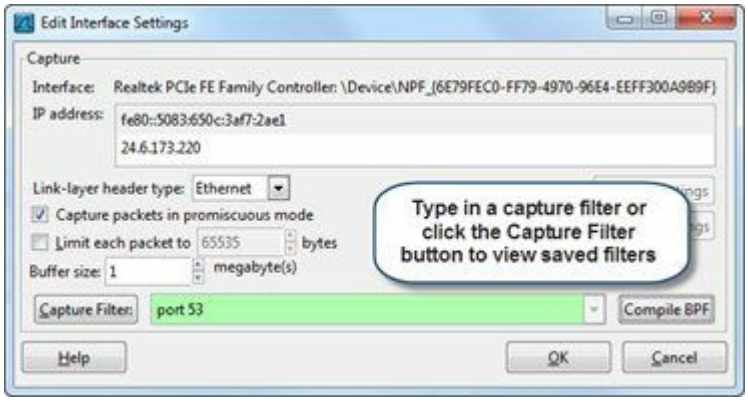
Figure 54. Place the tap between the server and the switch.

You also might consider capturing to file sets with a maximum file size of 100 MB. Wireshark really

doesn't like working with huge trace files. We covered using file sets in *Use Special Capture*

Techniques to Spot Sporadic Problems.





Apply a Capture Filter in the Capture Options Window

To apply a capture filter, select **Capture | Options...** . Expand the window to see the **Capture Filter**

column (which should be blank at this time). Double-click anywhere on the selected interface line, as

shown in Figure 55. This launches the Edit Interface Settings window.

Figure 55. Double-click the desired interface line to open the Edit Interface Settings window and apply a capture filter.

Figure 56 shows the Edit Interface Settings window, which is where you can set your capture filter. If

you know the syntax of your capture filter, simply type it in in the Capture Filter area. Remember—

Wireshark uses BPF (Berkeley Packet Filtering) syntax. This is the format supported by dumpcap for

capture filters.

Wireshark color codes the background as you type to alert you to capture filter errors. A red

background indicates the filter cannot be processed. Most likely, the capture filter contains a typo or

perhaps you used display filter syntax.

Click the **Capture Filter** button to view and select saved capture filters, if desired. For more

information on capture filtering techniques, see *Capture Traffic based on Addresses (MAC/IP).*

Figure 56. Wireshark provides color coding to help detect capture filter problems

For additional information on capture filters, visit *wiki.wireshark.org/CaptureFilters.*

2.8. Capture Traffic based on Addresses

(MAC/IP)

Capturing traffic to and from a particular IP address (or range of IP addresses) or a MAC address is a

key skill that you will use when focusing on a particular problem, studying an application's behavior,

or investigating a potentially breached host.

Capture filters use the BPF syntax and are actually applied by dumpcap, which is the tool that is called

by Wireshark to capture the packets. Display filters, which you will examine later in this book, use a

proprietary Wireshark format. Display filters are not limited by the capabilities of dumpcap and the

BPF syntax.

Before you get too excited with all the options for using capture filters, let me make a

recommendation. Use capture filters sparingly and display filters liberally. If you filter

something out using capture filters, you can never get those packets back. For example, if

you applied a display filter for traffic to and from port 80 and found that the browsing session

targeted a strange IP address for the web server, it would be nice to see the DNS process that

took place beforehand. Too late. You filtered those packets out. If you'd captured without a

capture filter, you would be able to work with display filters to focus on those port 80 packets

and then look at the DNS traffic.

Capture Traffic to or from a Specific IP Address

If you are capturing in a location where you see many hosts communicating, you might consider using

a capture filter for the IP address of the hosts whose traffic you are analyzing. The following provides

examples of IP address capture filters.

host 10.3.1.1: Capture traffic *to/from* 10.3.1.1

host 2406:da00:ff00::6b16:f02d: Capture traffic *to/from* the IPv6 address

2406:da00:ff00::6b16:f02d

not host 10.3.1.1: Capture all traffic *except* traffic *to/from* 10.3.1.1

src host 10.3.1.1: Capture traffic *from* 10.3.1.1

dst host 10.3.1.1: Capture traffic *to* 10.3.1.1

host 10.3.1.1 or host 10.3.1.2: Capture traffic *to/from* 10.3.1.1 and any host it is

communicating with and traffic *to/from* 10.3.1.2 and any host it is communicating with

host www.espn.com: Capture traffic *to/from* any IP address that resolves to *www.espn.com*

(this will only work if the host name can be resolved by Wireshark prior to capture)

Capture Traffic to or from a Range of IP Addresses

When you want to capture traffic to or from a group of addresses, you can use CIDR (Classless

Interdomain Routing) format or use the mask parameter.

net 10.3.0.0/16: Capture traffic *to/from* any host on network 10.3.0.0

net 10.3.0.0 mask 255.255.0.0

Same result as previous filter

ip6 net 2406:da00:ff00::/64

Capture traffic *to/from* any host on network 2406:da00:ff00:0000 (IPv6)

not dst net 10.3.0.0/16

Capture all traffic *except* traffic to an IP address starting with 10.3

dst net 10.3.0.0/16

Capture traffic *to* any IP address starting with 10.3

src net 10.3.0.0/16

Capture traffic *from* any IP address starting with 10.3

Capture Traffic to Broadcast or Multicast Addresses

You can learn a lot about hosts on the network by just listening to broadcast and multicast traffic.

ip broadcast: Capture traffic to 255.255.255.255

ip multicast: Capture traffic to 224.0.0.0 through 239.255.255.255 (also catches traffic to

255.255.255.255 unless you add and not ip broadcast)

dst host ff02::1: Capture traffic to the IPv6 multicast address for all hosts

dst host ff02::2: Capture traffic to the IPv6 multicast address for all routers

If you are just interested in all IP or IPv6 traffic, use the capture filters ip or ip6, respectively.

Refer to *Capture Traffic for a Specific Application* for more capture filter examples.

Capture filters can be used during command-line capture as well. For more information, refer to *Use*

Capture Filters during Command-Line Capture. Also refer to *wiki.wireshark.org/CaptureFilters.*

Wireshark includes a default set of capture filters. Click the ***Edit Capture Filters*** *button on*

the main toolbar to jump to the saved capture filters list. You'll find some good examples of

common capture filters used with Wireshark.

Capture Traffic based on a MAC Address

When you want to capture IPv4 or IPv6 traffic to or from a host, create a capture filter based on the

host's MAC address.

Since MAC headers are stripped off and applied by routers along a path, ensure you are on the same

network segment as the target host.

ether host 00:08:15:00:08:15: Capture traffic to or from 00:08:15:00:08:15

ether src 02:0A:42:23:41:AC: Capture traffic *from* 02:0A:42:23:41:AC

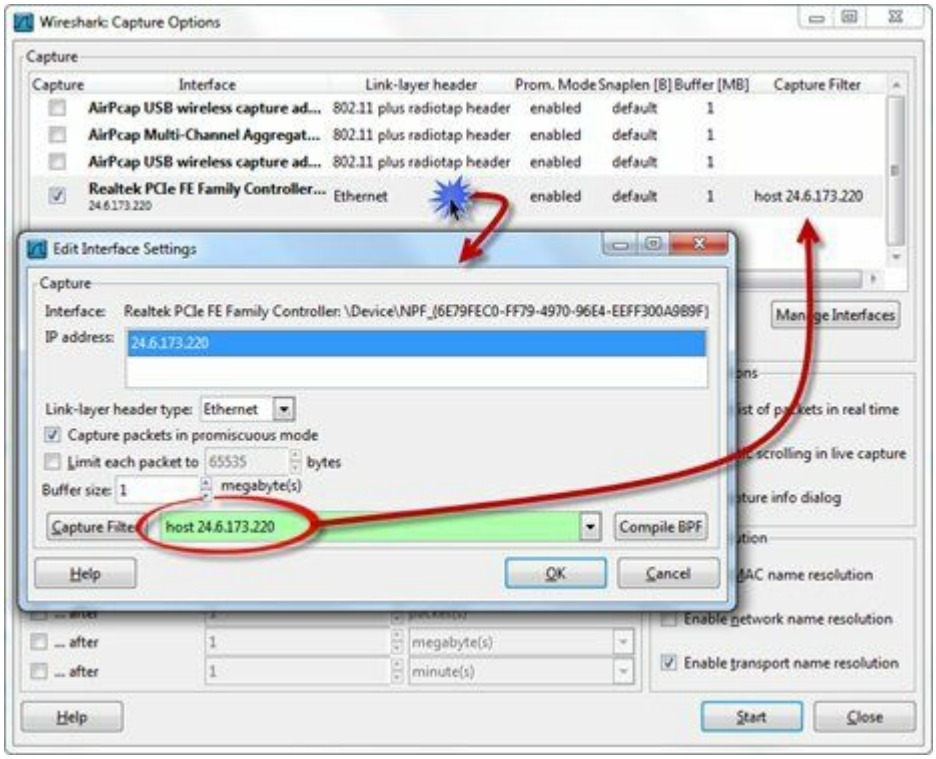
ether dst 02:0A:42:23:41:AC: Capture traffic *to* 02:0A:42:23:41:AC

not ether host 00:08:15:00:08:15: Capture traffic to or from any MAC address

except for traffic to or from 00:08:15:00:08:15

In Lab 13, you will create a NotMyMAC capture filter to listen in on the traffic to or from other hosts

on the network while not capturing your own traffic.


Wireshark: Capture Options
Capture
Capture Interface Link-layer header Prom. Mode Snaplen [B] Buffer [MB] Capture Filter
AirPcap USB wireless capture ad... 802.11 plus radiotap header enabled default 1
AirPcap Multi-Channel Aggregat... 802.11 plus radiotap header enabled default 1
AirPcap USB wireless capture ad... 802.11 plus radiotap header enabled default 1
Realtek PCIe FE Family Controller... Ethernet enabled default 1 host 24.6.173.220
24.6.173.220
Edit Interface Settings
Capture
Interface: Realtek PCIe FE Family Controller: \Device\NPF_{6E79FEC0-FF79-4970-96E4-EEFF300A9B9F}
IP address: 24.6.173.220
Link-layer header type: Ethernet
Capture packets in promiscuous mode
Limit each packet to 65535 bytes
Buffer size: 1 megabyte(s)
Capture Filter: host 24.6.173.220
Compile BPF
Help
OK
Cancel
Manage Interfaces
Enable network name resolution
Enable transport name resolution
megabyte(s)
minute(s)
Help
Start
Close

Lab 12: Capture Only Traffic to or from Your IP Address

In this lab you will determine your current IP address and apply a capture filter for that traffic.

Step 1: Click the **Capture Options** button

on the main toolbar.

Wireshark displays your IP addresses for the interfaces listed. You could also use either *ipconfig* or

ifconfig to copy your IP address and paste in to your filter if desired.

Step 2: Click the checkbox to select the desired interface. Notice that Wireshark displays your

adapter's IP address. You will use this address information to create your capture filter.

Step 3: In the capture area, double-click on the row that lists your selected interface. This launches the Edit Interface Settings window. In the capture filter area, enter host x.x.x.x (replacing x.x.x.x

with your IP address) to filter on your IPv4 traffic. If you are going to capture on your IPv6 address,

enter host xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx. Click **OK.**

Step 4: Return to Wireshark's Capture Options window. Be certain that **Use multiple files** in the

Capture File(s) area is unchecked and click **Start** to begin the capture process.

Step 5: Now open your command prompt and typeping www.chappellu.com.

Step 6: Toggle back to Wireshark and examine your trace file. All the traffic shown should be to or

from your IP address.

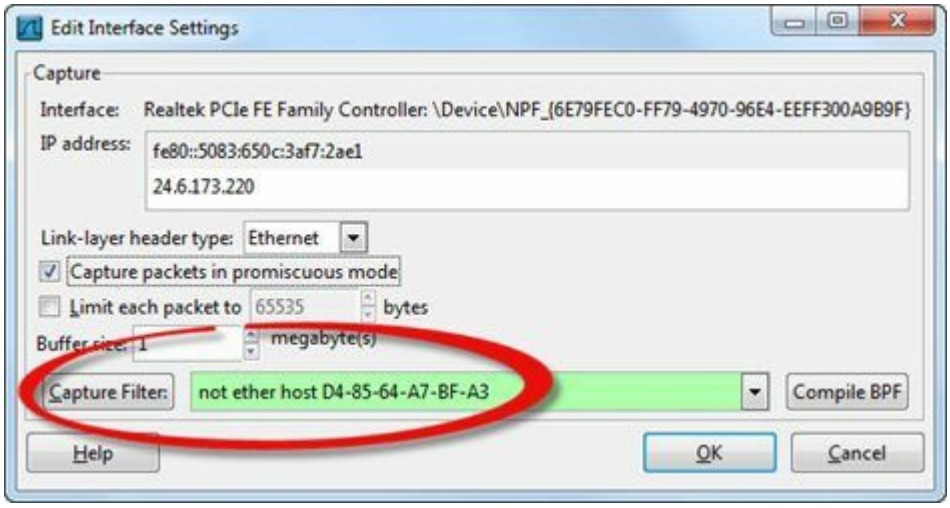
Step 7: [Lab Clean-up] Note that Wireshark retains many of your capture options. You will need to

check the capture option settings when you prepare for the next capture process.

Consider following the same steps to build a filter to or from your MAC address (create a "MyMAC"

filter). In the next lab, we will create a filter for everyone else's traffic (based on a MAC address

filter) and we will save our new capture filter.



Lab 13: Capture Only Traffic to or from Everyone Else's MAC Address

In this lab you will determine your current MAC address and apply a capture filter that filters out your

traffic—you are interested in everyone else's traffic only[26].

Step 1: Run either ***ipconfig*** or ***ifconfig*** at the command prompt to determine the MAC address of your active interface[27].

Step 2: Click on the **Capture Options** button

on the main toolbar.

Step 3: Click the checkbox to select the desired interface and double-click on the row that lists your

selected interface.

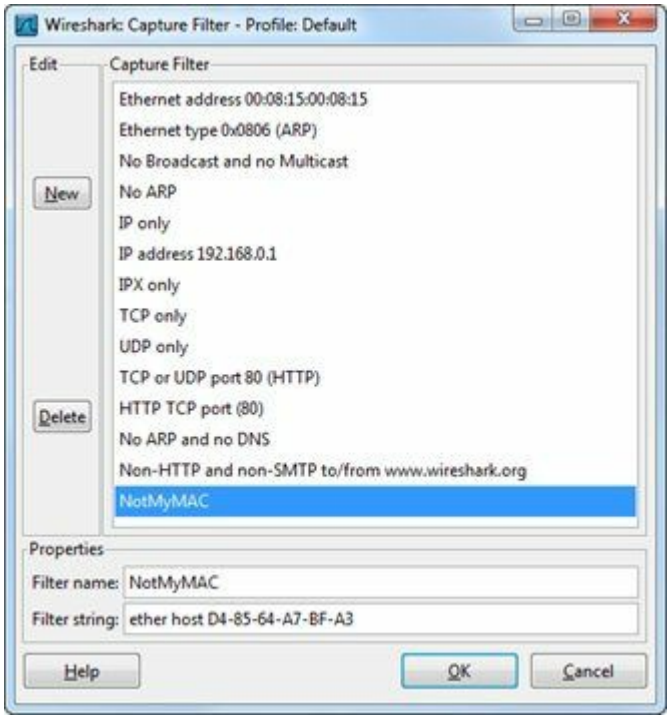
Step 4: In the Capture Filter area of the Edit Interface Settings window, enter

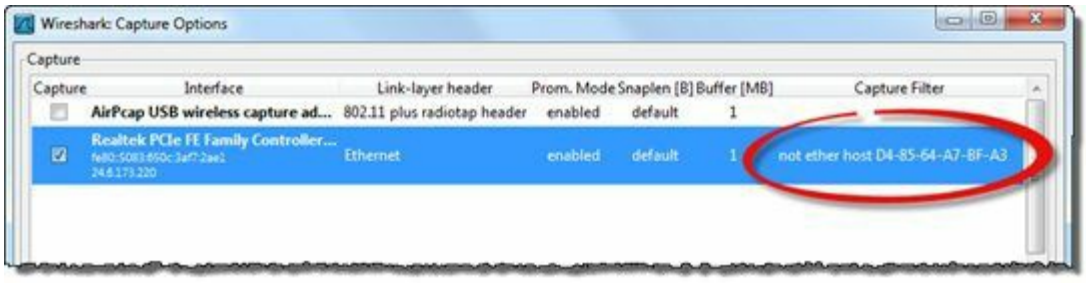
not ether host xx.xx.xx.xx.xx.xx using your Ethernet address.

Step 5: To save this new capture filter, click the **Capture Filter** button. Enter **NotMyMAC** in the Name area. The filter string value should already be set. Click the **New** button.

Step 6: Scroll through the list of capture filters—your new NotMyMAC filter should appear at the end

of the list as shown below. Click **OK**.





Step 7: Click **OK** to close the Capture Filter window. Click **OK** to close the Edit Interface Settings window. In your Capture Options

window you should see your new capture filter listed in the Capture

Options window. Expand the window if necessary.

We won't set up multiple file capture or auto-stop in this lab so leave those options unchecked.

Step 8: Click **Start** to begin the capture process. Now browse to various sites, login to your server, or send email.

Step 9: Toggle back to Wireshark and click the **Stop Capture** button.

Step 10: Scroll through your trace files to examine the traffic captured during your communications

processes. None of your traffic will be captured.

Step 11: [Lab Clean-up] Note that Wireshark retains many of your capture options. You will need to

check the capture option settings when you prepare for the next capture process.

There's no reason to capture your own traffic when you are analyzing someone else's communications.

Running your NotMyMAC filter will ensure your traffic is not caught during the capture process.

2.9. Capture Traffic for a Specific

Application

You will often want to look at traffic from a single application or even sets of applications. Get the

unrelated packets out of the way by applying a capture filter based on the TCP or UDP port number

used by your target application(s).

The capture filter syntax (Berkeley Packet Filtering format) does not recognize application names.

You need to define an application based on the port number in use.

It's all About the Port Numbers

Here is a quick list of some of the most popular application capture filters. For more information on

capture filters, refer to *wiki.wireshark.org/CaptureFilters.*

port 53: Capture UDP/TCP traffic to or from port 53 (typically DNS traffic)

not port 53: Capture all UDP/TCP traffic *except* traffic to or from port 53

port 80: Capture UDP/TCP traffic to or from port 80 (typically HTTP traffic)

udp port 67: Capture UDP traffic to or from port 67 (typically DHCP traffic)

tcp port 21: Capture TCP traffic to or from port 21 (typically the FTP command channel)

portrange 1-80: Capture UDP/TCP traffic to or from ports from 1 through 80

tcp portrange 1-80: Capture TCP traffic to or from ports from 1 through 80

Combine Port-based Capture Filters

When you want to capture traffic to or from various non-contiguous port numbers, combine them with

a logical operator, as shown below.

port 20 or port 21: Capture all UDP/TCP traffic *to or from* port 20 or port 21 (typically

FTP data and command ports)

host 10.3.1.1 and port 80: Capture UDP/TCP traffic *to or from* port 80 that is being

sent *to or from* 10.3.1.1

host 10.3.1.1 and not port 80: Capture UDP/TCP traffic *to or from* 10.3.1.1 *except*

traffic to or from port 80

udp src port 68 and udp dst port 67: Capture all UDP traffic from port 68 to port

67 (typically traffic sent from a DHCP client to a DHCP server)

udp src port 67 and udp dst port 68: Capture all UDP traffic from port 67 to port

68 (typically traffic sent from a DHCP server to a DHCP client)

Try to avoid capture filters whenever possible. I cannot stress this enough! It is much better to have

too much traffic to wade through than to find out you're missing a piece of the picture. Once you

capture this large amount of traffic, use display filters (which offer many more filtering options) to

focus on specific traffic.

If you need to make capture filters that look for a specific ASCII string in a TCP frame, use

Wireshark's String-Matching Capture Filter Generator (http://www.wireshark.org/tools/string-

cf.html). For example, if you only want to capture HTTP GET requests, simply enter in the

*string **GET** and set the TCP offset to 0 (where HTTP request methods, or commands, reside).*

2.10. Capture Specific ICMP Traffic

Internet Control Messaging Protocol (ICMP) is a protocol you should watch for when performance or

security issues plague a network.

The table below shows the structure of numerous ICMP capture filters. In this case we must use an

offset to indicate the field location in an ICMP packet. Offset 0 is the ICMP Type field and offset 1 is

the location of the ICMP Code field.

icmp: Capture all ICMP packets.

icmp[0]=8: Capture all ICMP Type 8 (Echo Request) packets.

icmp[0]=17: Capture all ICMP Type 17 (Address Mask Request) packets.

icmp[0]=8 or icmp[0]=0: Capture all ICMP Type 8 (Echo Request) packets or ICMP

Type 0 (Echo Reply) packets.

icmp[0]=3 and not icmp[1]=4: Capture all ICMP Type 3 (Destination Unreachable)

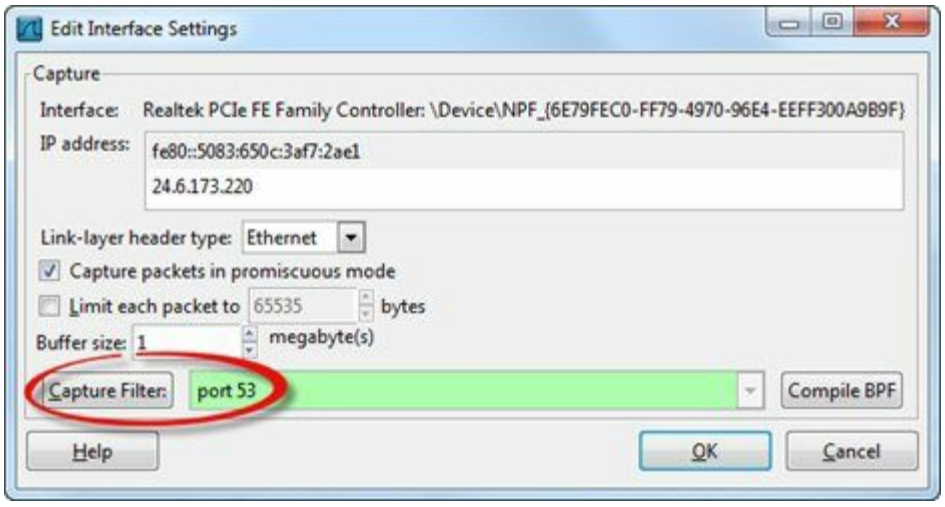
packets except for ICMP Type 3/Code 4 (Fragmentation Needed and Don't Fragment was Set)

packets.

Although we could have listed not icmp as a possible capture filter above, you likely would never

want to use that filter since ICMP provides so much information about network activity and

configurations.



Lab 14: Create, Save and Apply a DNS Capture Filter

In this exercise you will use several skills learned in this chapter. You will configure Wireshark to

capture only DNS traffic and save that traffic to a file called *mydns101.pcapng*.

Step 1: Click the **Capture Options** button

on the main toolbar.

Step 2: Click the checkbox in front of the adapter you are currently using to connect to the Internet.

Step 3: In the capture area, double-click on the row that lists your selected interface. This launches the Edit Interface Settings window. In the Capture Filter area, enter **port 53**, as shown below. The

background turns from white to red to green as you type in the filter.

Step 4: To save this new capture filter, click the **Capture Filter** button. Enter **DNS** in the Name area.

The filter string value should already be set. Click the **New** button.

Step 5: Scroll to the end of capture filters list. Your new DNS filter should appear at the end of the

list. Click **OK**. Click **OK** on the Edit Interface Settings window.

Step 6: In the Capture File(s) area of the Capture Options window, click the **Browse** button to

navigate to and select the directory in which you want to save your trace files. Enter

mydns101.pcapng in the Name area. Click **OK**.

Step 7: Toggle back to the Capture Options window. Your directory and file name should appear in

the File section. Select **Use multiple Files** and define the next file every **1 MB** and next file every **10 seconds**. Whichever condition is met first causes the creation of the next file. Do not set a Ring

Buffer value or auto-stop condition. You will manually stop the capture process.

Step 8: Click **Start** to begin the capture process.

Start browsing to 5 different sites on the Internet. For example, you could visit two news sites, a bank

site, Amazon and *www.wireshark.org*. Try to visit sites that you have not browsed to recently to ensure

DNS information is not loaded from your cache.

Step 9: Toggle back to Wireshark and click the **Stop Capture** button.

Step 10: Scroll through your trace file(s) to examine the DNS traffic generated during your browsing

process. You may be surprised to see how many DNS queries are generated when you browse these

sites.

Step 11: [Lab Clean-up] Note that Wireshark retains many of your capture options. You will need to

check the capture option settings when you prepare for the next capture process.

Consider saving any capture filter that you might use more than once. This will save you time if you

need to repeatedly use a complex capture filter.

Chapter 2 Challenge

This challenge requires access to the Internet. You will capture traffic to a web site and analyze your

findings. The answer key is located in Appendix A.

First, configure Wireshark to capture only traffic to and from your MAC address and port 80, and save

the traffic to a file named *mybrowse.pcapng*. Then ping and browse to *www.chappellU.com*. Stop the capture and examine the trace file contents.

Question 2-1.

Did you capture any ICMP traffic?

Question 2-2.

What protocols are listed for your browsing session to *www.chappellU.com*?

Now configure Wireshark to capture all your ICMP traffic, and save your traffic to a file called

myicmp.pcapng. Again, ping and browse to *www.chappellU.com*. Stop the capture and examine the

trace file contents.

Question 2-3.

How many ICMP packets did you capture?

Question 2-4.

What ICMP Type and Code numbers are listed in your trace file?

Chapter 3 Skills: Apply Display Filters to

Focus on Specific Traffic

"Wireshark is an extraordinary tool for network analysis and discovery. It's obviously critical for

debugging low-level network problems, but I find it's often the best way to debug higher level

applications too. Web traffic is one such example. Sure, I could read the web server logs, but those

often omit critical details. Network traffic, on the other hand, doesn't lie. It shows me exactly what is

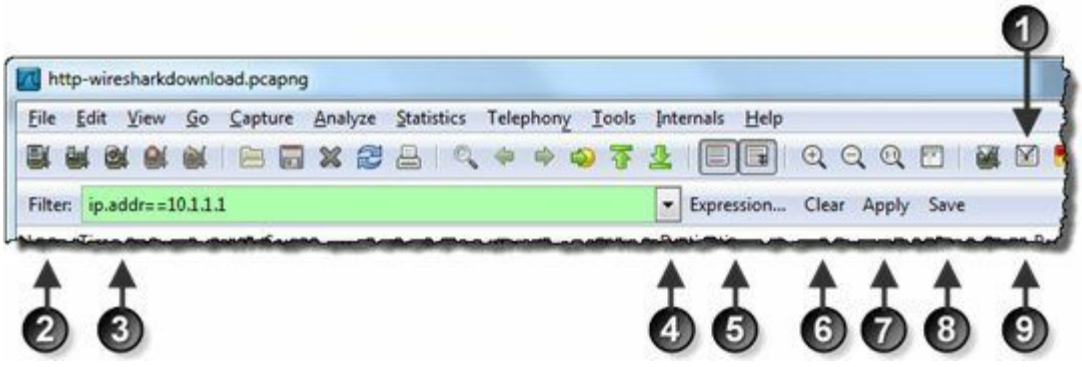
going on.

Wireshark may appear complex and intimidating when you first start it up, but with a little guidance

and practice you'll find that it's easier than you think."

Gordon "Fyodor" Lyon

Founder of the Open Source Nmap Security Scanner Project



Quick Reference: Display Filter Area

1. View, edit and create display filters (main toolbar)

2. Display Filters button (another way to view, edit and create display filters)

3. Display Filter Area (includes auto-complete and error detection)

4. Last used display filter drop down list

5. Expressions to walk you through creating display filters

6. Clears the display filter area so no display filter is applied to the trace file

7. Applies the currently shown display filter during a live capture or to an opened trace file

8. Saves the display filter as a Filter Expression button

9. Filter Expression Button area (blank until new buttons are created)

3.1. Use Proper Display Filter Syntax

Becoming a master of display filters is absolutely essential to the network analyst. This is the skill

you will use to find the needle in the haystack. Learn to build, edit, and save key display filters to save

yourself many hours of frustration wading through "packet muck."

Whereas capture filters use the BPF syntax, display filters use a Wireshark proprietary format. Except

for a few instances, Wireshark capture filters and display filters look very different.

The Syntax of the Simplest Display Filters

The simplest display filters are based on a protocol, application, field name, or characteristic. Display

filters are case sensitive. Most of these simple display filters use lower case[28] characters.

Protocol Filters

arp: Displays all ARP traffic including gratuitous ARPs, ARP requests, and ARP replies

ip: Displays all IPv4 traffic including packets that have IPv4 headers embedded in them (such as

ICMP destination unreachable packets that return the incoming IPv4 header after the ICMP

header)

ipv6: Displays all IPv6 traffic including IPv4 packets that have IPv6 headers embedded in them,

such as 6to4, Teredo, and ISATAP traffic

tcp: Displays all TCP-based communications

Application Filters

bootp: Displays all DHCP traffic (which is based on BOOTP). See *Determine Why Your dhcp*

Display Filter Doesn't Work.

dns: Displays all DNS traffic including TCP-based zone transfers and the standard UDP-based

DNS requests and responses

tftp: Displays all TFTP (Trivial File Transfer Protocol) traffic

http[29]: Displays all HTTP commands, responses and data transfer packets, but does not display the TCP handshake packets, TCP

ACK packets or TCP connection teardown packets

icmp: Displays all ICMP traffic

Field Existence Filters

bootp.option.hostname: Displays all DHCP traffic that contains a host name (DHCP is

based on BOOTP)

http.host: Displays all HTTP packets that have the HTTP host name field. This packet is sent

by the clients when they send a request to a web server

ftp.request.command: Displays all FTP traffic that contains a command, such as the

USER, PASS, or RETR commands

Characteristic Filters

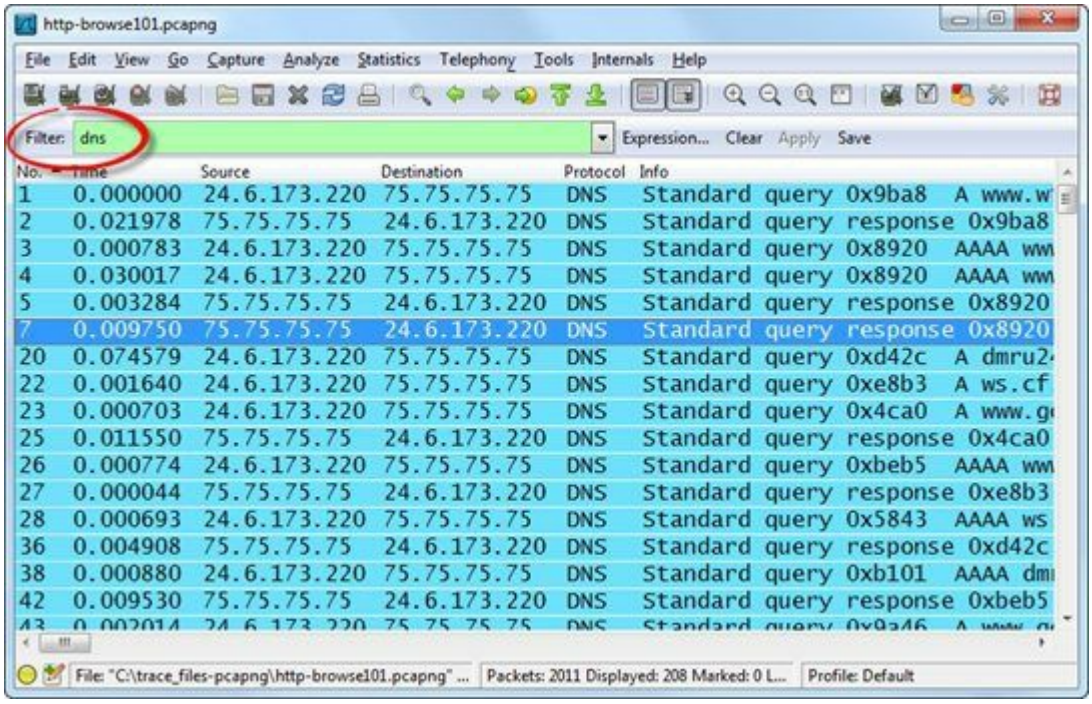
tcp.analysis.flags: Displays all packets that have any of the TCP analysis

flags associated with them—this includes indications of packet loss, retransmissions, or zero

window conditions

tcp.analysis.zero_window: Displays packets that are flagged to indicate the sender has

run out of receive buffer space


http-browse101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: dns
Expression... Clear Apply Save
No. Time Source Destination Protocol Info
1 0.000000 24.6.173.220 75.75.75.75 DNS Standard query 0x9ba8 A www.w
2 0.021978 75.75.75.75 24.6.173.220 DNS Standard query response 0x9ba8
3 0.000783 24.6.173.220 75.75.75.75 DNS Standard query 0x8920 AAAA ww
4 0.030017 24.6.173.220 75.75.75.75 DNS Standard query 0x8920 AAAA ww
5 0.003284 75.75.75.75 24.6.173.220 DNS Standard query response 0x8920
7 0.009750 75.75.75.75 24.6.173.220 DNS Standard query response 0x8920
20 0.074579 24.6.173.220 75.75.75.75 DNS Standard query 0xd42c A dmru2
22 0.001640 24.6.173.220 75.75.75.75 DNS Standard query 0xe8b3 A ws.cf
23 0.000703 24.6.173.220 75.75.75.75 DNS Standard query 0x4ca0 A www.g
25 0.011550 75.75.75.75 24.6.173.220 DNS Standard query response 0x4ca0
26 0.000774 24.6.173.220 75.75.75.75 DNS Standard query 0xbeb5 AAAA ww
27 0.000044 75.75.75.75 24.6.173.220 DNS Standard query response 0xe8b3
28 0.000693 24.6.173.220 75.75.75.75 DNS Standard query 0x5843 AAAA ws
36 0.004908 75.75.75.75 24.6.173.220 DNS Standard query response 0xd42c
38 0.000880 24.6.173.220 75.75.75.75 DNS Standard query 0xb101 AAAA dm
42 0.009530 75.75.75.75 24.6.173.220 DNS Standard query response 0xbeb5
File: "C:\trace_files-pcapng\http-browse101.pcapng" ...
Packets: 2011 Displayed: 208 Marked: 0 L...
Profile: Default

The most common mistake made when entering a display filter is using capture filter syntax.

Capture filters use the BPF format whereas display filters use a proprietary format. There are

a few times when the same filter works as both a capture and display filter. For example, ip

and icmp can be used both as capture filters and display filters.

In Figure 57, we filtered on the DNS traffic in a web browsing session. This is a great filter when you

want to know the interdependencies between web sites. Using this filter, we can see that browsing to

www.wireshark.org causes a storm of DNS queries to resolve the IP addresses associated with the

links on the page.

Figure 57. We filtered on all the DNS traffic to see what host names were resolved. [http–browse101.pcapng]

Use the Display Filter Error Detection Mechanism

Remember that display filters are case sensitive. If you type DNS instead of dns, Wireshark will show

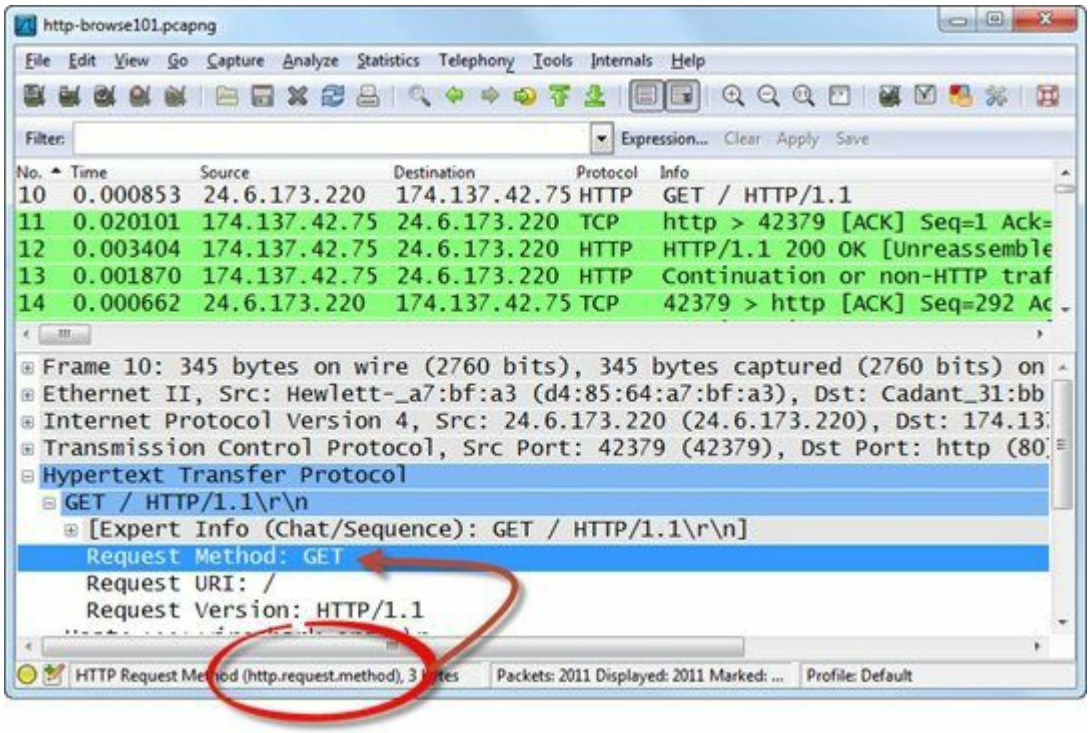
a red background in the display filter area to indicate this filter will not work. A yellow background is

a warning that your filter may not work as desired. A green background indicates your filter is

properly formed, but be careful. Wireshark does not do a logic test.

We will look into display filter problems in *Determine Why Your dhcp Display Filter Doesn't Work*

and *Why didn't my ip.addr != filter work? .*


http-browse101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Info
10 0.000853 24.6.173.220 174.137.42.75 HTTP GET / HTTP/1.1
11 0.020101 174.137.42.75 24.6.173.220 TCP http > 42379 [ACK] Seq=1 Ack=
12 0.003404 174.137.42.75 24.6.173.220 HTTP HTTP/1.1 200 OK [Unreassemble
13 0.001870 174.137.42.75 24.6.173.220 HTTP Continuation or non-HTTP traf
14 0.000662 24.6.173.220 174.137.42.75 TCP 42379 > http [ACK] Seq=292 Ac
Frame 10: 345 bytes on wire (2760 bits), 345 bytes captured (2760 bits) on
Ethernet II, Src: Hewlett-_a7:bf:a3 (d4:85:64:a7:bf:a3), Dst: Cadant_31:bb
Internet Protocol Version 4, Src: 24.6.173.220 (24.6.173.220), Dst: 174.13
Transmission Control Protocol, Src Port: 42379 (42379), Dst Port: http (80
Hypertext Transfer Protocol
GET / HTTP/1.1\r\n
[Expert Info (Chat/Sequence): GET / HTTP/1.1\r\n]
Request Method: GET
Request URI: /
Request Version: HTTP/1.1
HTTP Request Method (http.request.method), 3
Packets: 2011 Displayed: 2011 Marked: ...
Profile: Default

Learn the Field Names

Many of the display filters you will apply are based on field names (such as http.host). To learn a

field name, select the field in the Packet Display list and look at the Status Bar, as shown in Figure 58.

In this example, we clicked on frame 10 in the Packet List pane and then expanded the HTTP header in

the Packet Details pane. When we clicked on the Request Method line in the HTTP section of the

packet, the Status Bar indicated this field is called http.request.method.

Figure 58. Click on a field and look at the Status Bar to learn the field name. You may need to expand this column to see the entire field name. [http–browse101.pcapng]

We typed http.request.method in the display filter area to display all packets that contain this

field[30].

We applied this filter in Figure 59. Notice that the Status Bar indicates that this trace file, *http-*

browse101.pcapng, contains 2011 packets and only 101 packets match our filter.

This is a great filter to determine what elements are requested by an HTTP client. Web servers do not

send HTTP request methods, they send HTTP response codes. In Lab 19 you will build a filter for the

HTTP 404 response code.

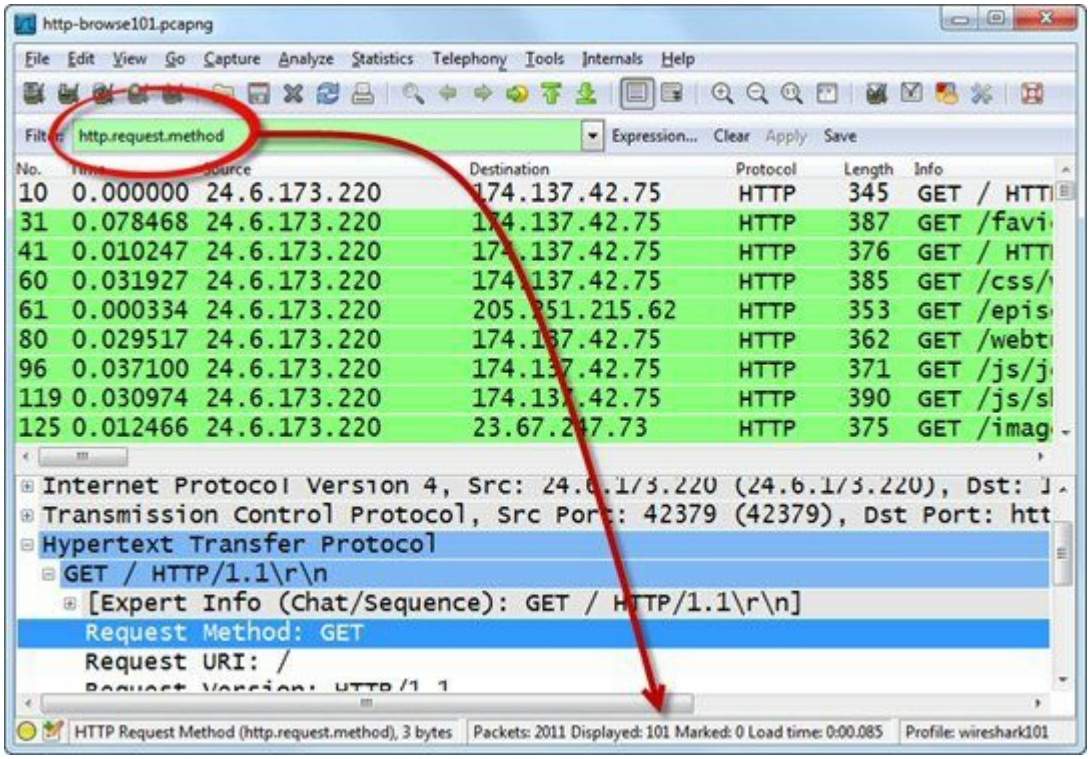
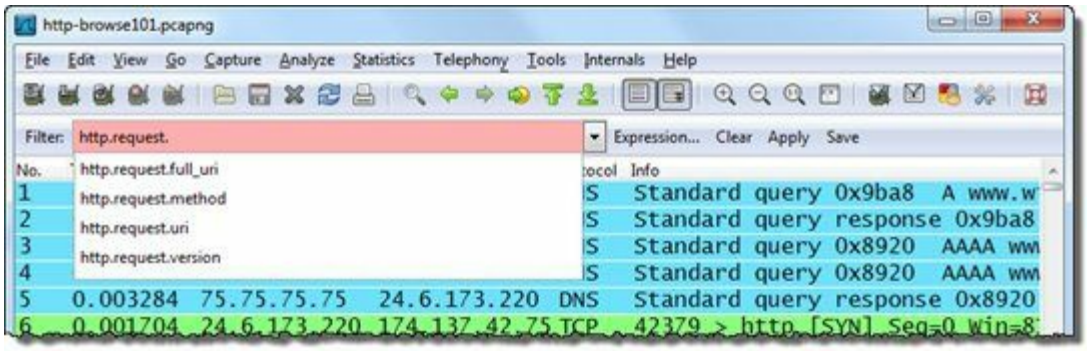
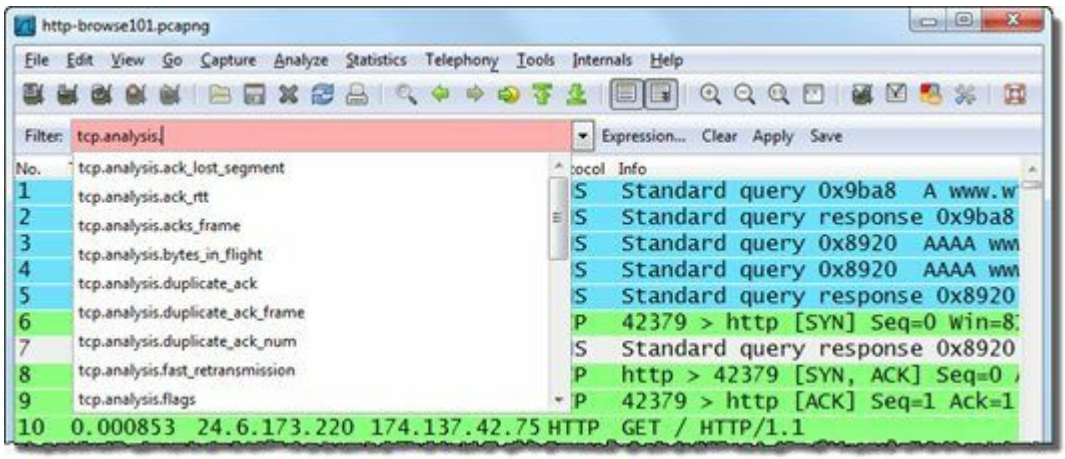

http-browse101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: http.request.method
Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
10 0.000000 24.6.173.220 174.137.42.75 HTTP 345 GET / HTTP
31 0.078468 24.6.173.220 174.137.42.75 HTTP 387 GET /favi
41 0.010247 24.6.173.220 174.137.42.75 HTTP 376 GET / HTTP
60 0.031927 24.6.173.220 174.137.42.75 HTTP 385 GET /css/
61 0.000334 24.6.173.220 205.251.215.62 HTTP 353 GET /epis
80 0.029517 24.6.173.220 174.137.42.75 HTTP 362 GET /webt
96 0.037100 24.6.173.220 174.137.42.75 HTTP 371 GET /js/j
119 0.030974 24.6.173.220 174.137.42.75 HTTP 390 GET /js/s
125 0.012466 24.6.173.220 23.67.247.73 HTTP 375 GET /imag
Internet Protocol Version 4, Src: 24.6.173.220 (24.6.173.220), Dst:
Transmission Control Protocol, Src Port: 42379 (42379), Dst Port: htt
Hypertext Transfer Protocol
GET / HTTP/1.1\r\n
[Expert Info (Chat/Sequence): GET / HTTP/1.1\r\n]
Request Method: GET
Request URI: /
HTTP Request Method (http.request.method), 3 bytes
Packets: 2011 Displayed: 101 Marked: 0 Load time: 0:00.085
Profile: wireshark101

Figure 59. Look at the Status Bar to determine how many packets matched your filter. You may need to expand the Packets section of the Status Bar to see the Displayed information. [http–browse101.pcapng]


http-browse101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: http.request.
Expression... Clear Apply Save
http.request.full_uri
http.request.method
http.request.uri
http.request.version
No. Info
1 Standard query 0x9ba8 A www.w
2 Standard query response 0x9ba8
3 Standard query 0x8920 AAAA ww
4 Standard query 0x8920 AAAA ww
5 0.003284 75.75.75.75 24.6.173.220 DNS Standard query response 0x8920
6 0.001704 24.6.173.220 174.137.42.75 TCP 42379 > http [SYN] Seq=0 Win=8



Use Auto-Complete to Build Display Filters

As you type http.request.method in the filter area, Wireshark opens a window to "walk you

through" the filter options. When you type http. (including the dot), you see a list of all possible

display filters that begin with this string. Continue typing **http.request.** and you will see filters

that begin with this phrase, as shown in Figure 60.

Figure 60. The auto-complete feature can help you build your display filter. [http–browse101.pcapng]

You can use this auto-complete feature to discover available display filters. For example, if you type

tcp. (again including the dot), Wireshark lists all TCP filters available. If you type

tcp.analysis. **,** Wireshark lists all of the TCP analysis filters dealing with TCP problems and

performance, as shown in Figure 61. You can click on any listed filter to use it in the display filter

area.

*Figure 61. Type **tcp.analysis.** to determine what TCP analysis flag filters are available. [http–browse101.pcapng]*

Display Filter Comparison Operators

You can expand your filter to look for a particular value in a field. Wireshark supports numerous

comparison operators for this purpose. The following lists Wireshark's seven comparison operators.

1. == or eq

Example: ip.src == 10.2.2.2

Display all IPv4 traffic from 10.2.2.2

2. != or ne

Example: tcp.srcport != 80

Display all TCP traffic from any port *except* port 80[31]

3. > or gt

Example: frame.time_relative > 1

Display packets that arrived more than 1 second after the previous packet in the trace file

4. < or lt

Example: tcp.window_size < 1460

Display when the TCP receive window size is less than 1460 bytes

5. >= or ge

Example: dns.count.answers >= 10

Display DNS response packets that contain at least 10 answers

6. <= or lt

Example: ip.ttl < 10

Display any packets that have less than 10 in the IP Time to Live field

7. contains

Example: http contains "GET"

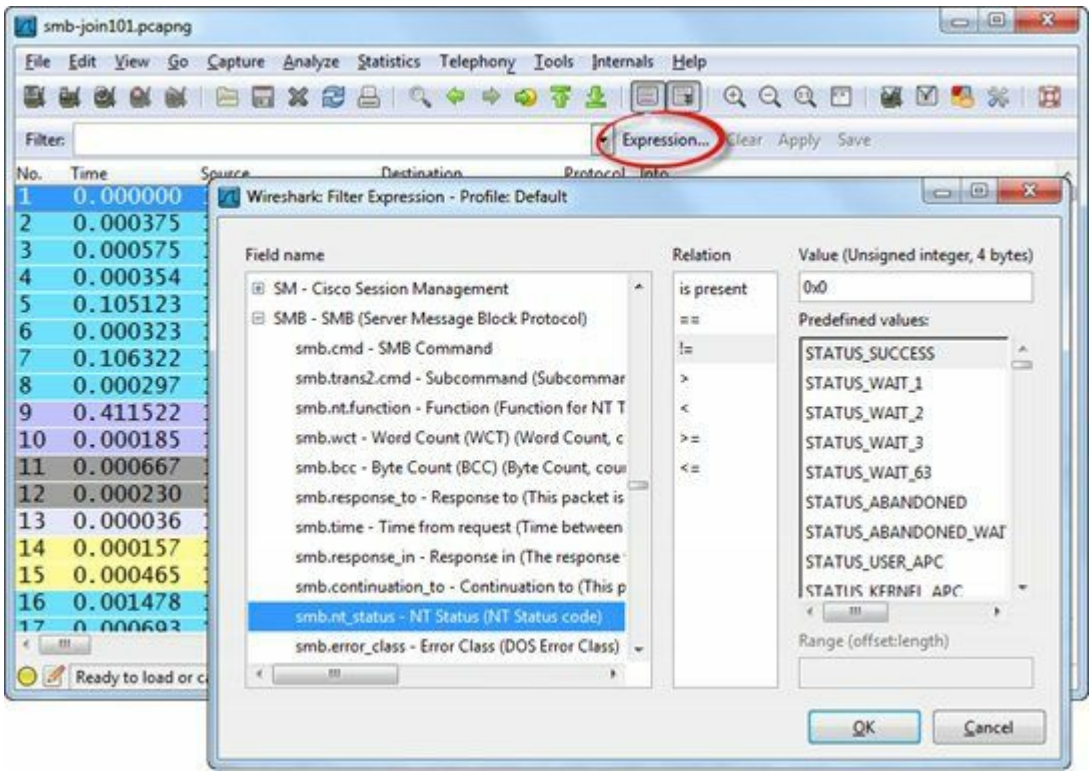
Display all the HTTP client GET requests sent to HTTP servers

Use comparison operators when filtering for TCP-based applications. For example, if you want to see

your HTTP traffic that runs over port 80, use tcp.port==80.

You do not need a space on either side of an operator. The filter ip.src==10.2.2.2 works

the same as ip.src == 10.2.2.2.



Use Expressions to Build Display Filters

If you absolutely have no idea how to filter on something, click the **Expression** button on the display

filter toolbar. In the Filter Expression window, you can type the name of the application or protocol in

which you are interested to jump to that point in the Field Name list. In Figure 62, we typed in "SMB"

and expanded SMB to view the available fields.

The Relation option can be used to either create a field existence filter (field is present) or to add a

comparison operator. On the right side of the Filter Expression window, you may find predefined

values for the field you select. Unfortunately, not all fields are broken out as thoroughly as the

smb.nt_status field.

We selected smb.nt_status as the field, != as the relation and STATUS_SUCCESS as the predefined

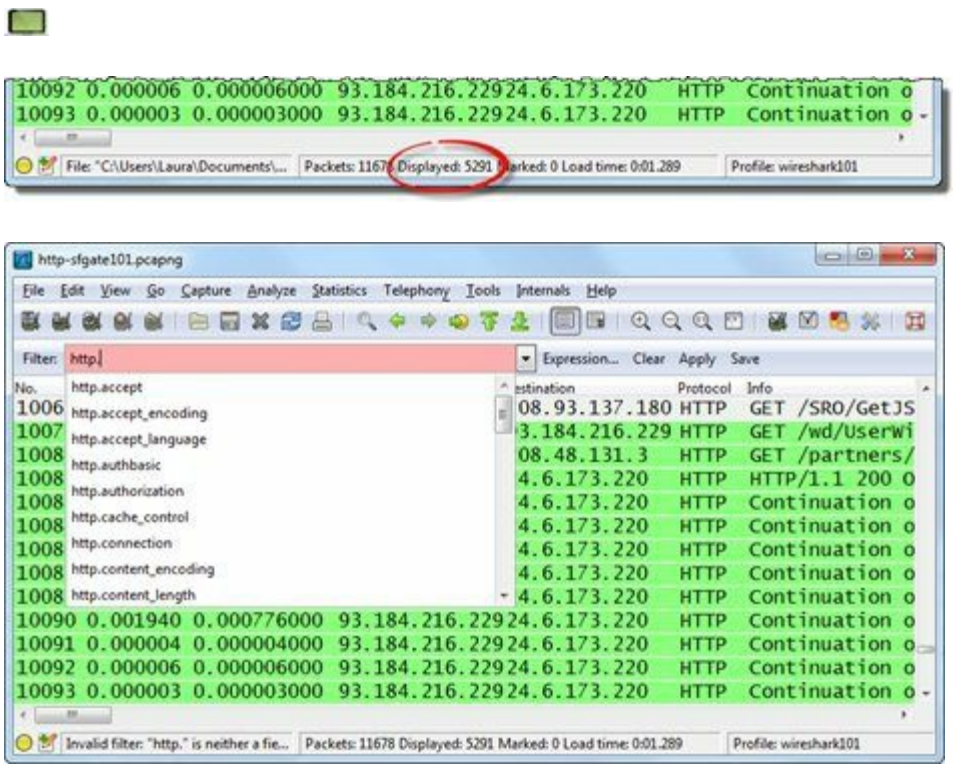
value. Wireshark displays the value 0x0 which is the value seen in the NT Status field in responses

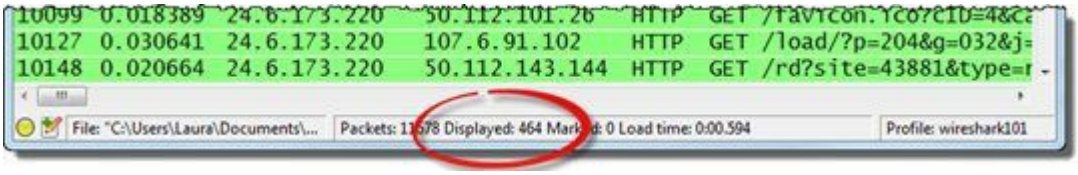
indicating success. Since we selected the != operator, we are looking for responses that are not

successful. When we clicked **OK**, Wireshark placed smb.nt_status != 0x0 in the display filter

area. You must click the **Apply** button to place the place the filter on the traffic.

Figure 62. We are using Expressions to create a filter for SMB error responses (SMB NT status values other than 0x0, STATUS_SUCCESS). [smb-join101.pcapng]





Lab 15: Use Auto-Complete to Find Traffic to a Specific

HTTP Server

In this lab we use Wireshark's auto-complete feature to filter on specific HTTP communications.

Ultimately, we are interested in client requests to a particular server. This trace file, *http–*

sfgate101.pcapng, was captured as someone browsed a web site and then filled in a feedback form on

that site asking about iPad support.

Step 1: Open ***http-sfgate101.pcapng***. Scroll through the trace file to get a feel for the traffic. You should see lots of DNS and HTTP traffic in this trace file. The target site, SF Gate, is an online paper

focused on events in San Francisco, California. The online paper is owned by the Hearst Corporation

—you will see numerous references to "Hearst" in the trace file[32].

Step 2: We will use the auto-complete feature to begin this display filter. In the display filter area,

type http and click **Apply**. Look at the Status Bar—it should indicate that 5,291 packets matched

your filter if the TCP *Allow subdissector to reassemble TCP streams* preference setting is disabled

(refer to Lab 6). Your filter will display 950 packets if this TCP preference is enabled.

Step 3: Return to your display filter and add a **"."** (dot) after **http**. A drop-down menu appears listing all the filters available that begin with the **http.** pattern.

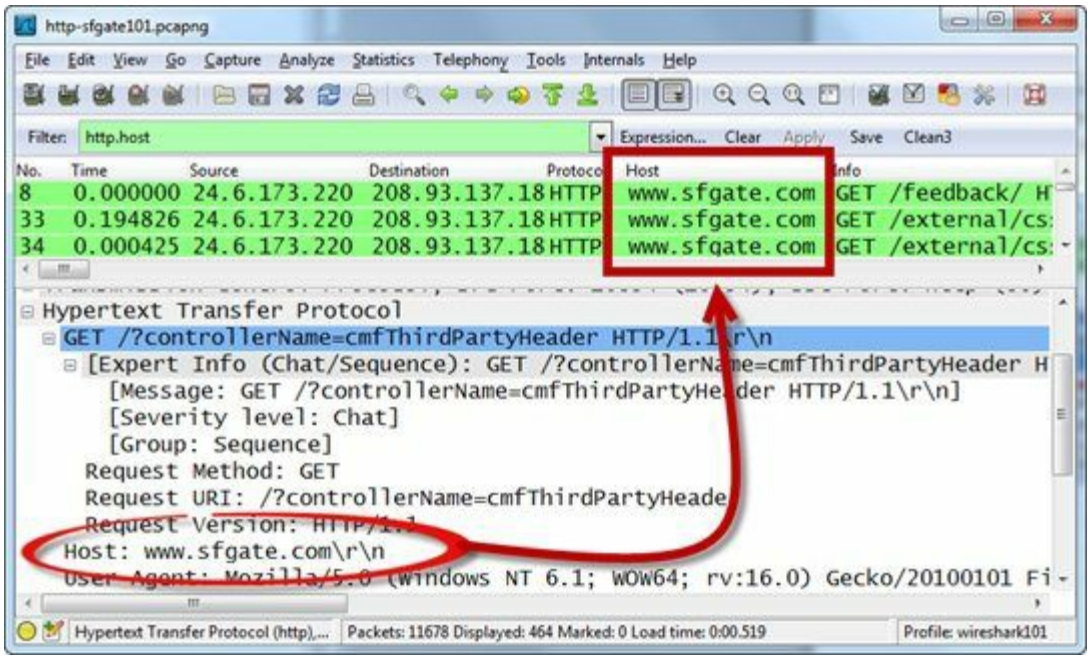
Step 4: Let's use this list to find out what HTTP hosts were accessed in this trace file. Scroll down the list to find and double-click http.host. Click **Apply**. The Status Bar should indicate that 464

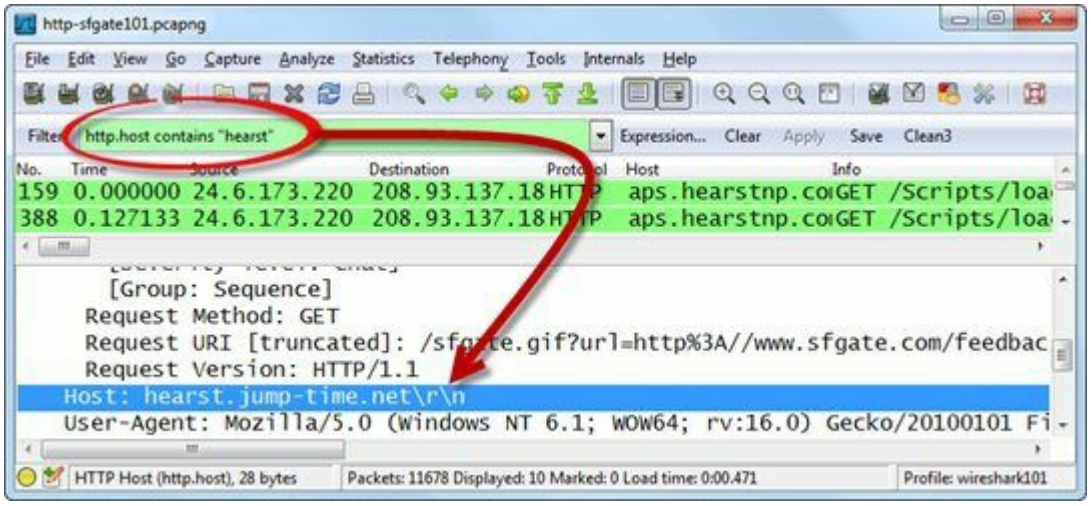
packets matched your filter. Each of those packets contains an HTTP Host field.

Step 5: You certainly do not want to scroll through 464 packets to look into the HTTP Host field of

each packet. Let's add a column for this field so we can easily see which hosts were contacted.

This **Host** column may already exist since you created this column in Lab 4. If your **Host** column is


http-sfgate101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: http.host
Expression... Clear Apply Save Clean3
No. Time Source Destination Protocol Host Info
8 0.000000 24.6.173.220 208.93.137.18 HTTP www.sfgate.com GET /feedback/ H
33 0.194826 24.6.173.220 208.93.137.18 HTTP www.sfgate.com GET /external/cs
34 0.000425 24.6.173.220 208.93.137.18 HTTP www.sfgate.com GET /external/cs
Hypertext Transfer Protocol
GET /?controllerName=cmfThirdPartyHeader HTTP/1.1\r\n
[Expert Info (Chat/Sequence): GET /?controllerName=cmfThirdPartyHeader H
[Message: GET /?controllerName=cmfThirdPartyHeader HTTP/1.1\r\n]
[Severity level: Chat]
[Group: Sequence]
Request Method: GET
Request URI: /?controllerName=cmfThirdPartyHeade
Request Version: HTTP/1.1
Host: www.sfgate.com\r\n
User-Agent: Mozilla/5.0 (Windows NT 6.1; WOW64; rv:16.0) Gecko/20100101 Fi
Hypertext Transfer Protocol (http),...
Packets: 11678 Displayed: 464 Marked: 0 Load time: 0:00.519
Profile: wireshark101


http-sfgate101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: http.host contains "hearst"
Expression... Clear Apply Save Clean3
No. Time Source Destination Protocol Host Info
159 0.000000 24.6.173.220 208.93.137.18 HTTP aps.hearstnp.co GET /Scripts/loa
388 0.127133 24.6.173.220 208.93.137.18 HTTP aps.hearstnp.co GET /Scripts/loa
[Group: Sequence]
Request Method: GET
Request URI [truncated]: /sfgate.gif?url=http%3A//www.sfgate.com/feedbac
Request Version: HTTP/1.1
Host: hearst.jump-time.net\r\n
User-Agent: Mozilla/5.0 (Windows NT 6.1; WOW64; rv:16.0) Gecko/20100101 Fi
HTTP Host (http.host), 28 bytes
Packets: 11678 Displayed: 10 Marked: 0 Load time: 0:00.471
Profile: wireshark101

hidden, right-click on any column heading, select **Displayed Columns** and click on the hidden **Host**

(*http.host*) column entry.

If your **Host** column was not saved, click on any packet displayed, expand the **Hypertext Transfer**

Protocol section in the Packet Details pane (use right-click and select **Expand Subtrees** to fully

expand the HTTP section of the packet).

Right-click on the **Host** field and select **Apply as Column**.

Step 6: Scroll through the trace file to see the numerous hosts that the client requested files from

during this web browsing session. Consider using this **Host** column when you are analyzing web

browsing sessions.

Now let's find out what the client sent to a particular server. As mentioned earlier in this lab, SF Gate

is owned by the Hearst Corporation.

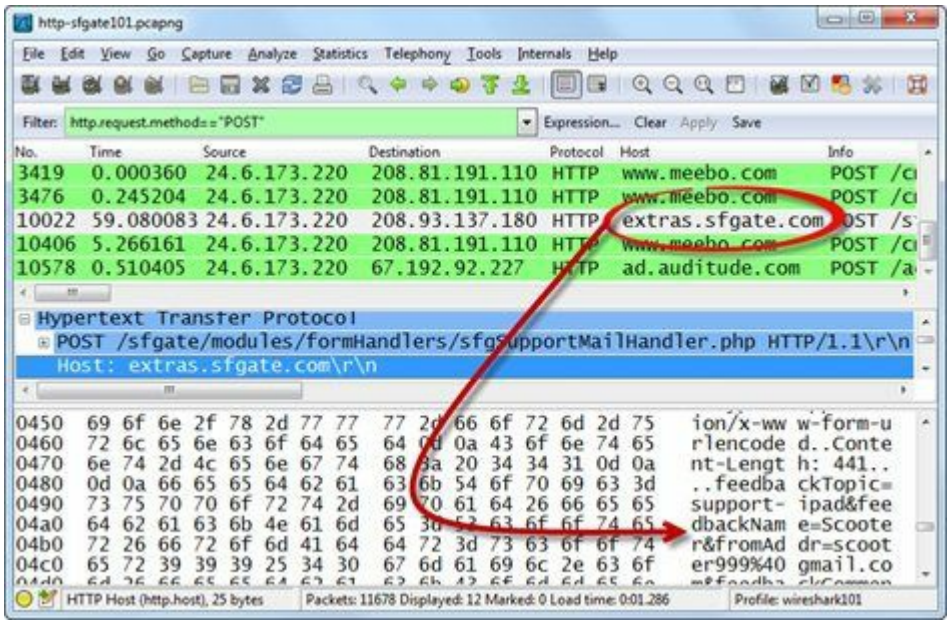
Type in the filter area to expand your display filter to http.host contains "hearst".

Only 10 packets should match your filter now.

Step 7: It's time to look specifically for a POST command.

First, examine the HTTP section of any packet in the Packet Details pane**.** Make sure the HTTP section

is fully expanded. Click on the **Request Method** field in one of these HTTP packets (just a few lines


http-sfgate101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: http.request.method=="POST"
Expression... Clear Apply Save
No. Time Source Destination Protocol Host Info
3419 0.000360 24.6.173.220 208.81.191.110 HTTP www.meebo.com POST /ci
3476 0.245204 24.6.173.220 208.81.191.110 HTTP www.meebo.com POST /ci
10022 59.080083 24.6.173.220 208.93.137.180 HTTP extras.sfgate.com POST /s
10406 5.266161 24.6.173.220 208.81.191.110 HTTP www.meebo.com POST /ci
10578 0.510405 24.6.173.220 67.192.92.227 HTTP ad.auditude.com POST /a
Hypertext Transfer Protocol
POST /sfgate/modules/formHandlers/sfgSupportMailHandler.php HTTP/1.1\r\n
Host: extras.sfgate.com\r\n
0450 69 6f 6e 2f 78 2d 77 77 77 2d 66 6f 72 6d 2d 75 ion/x-ww w-form-u
0460 72 6c 65 6e 63 6f 64 65 64 0d 0a 43 6f 6e 74 65 rlencode d..Conte
0470 6e 74 2d 4c 65 6e 67 74 68 3a 20 34 34 31 0d 0a nt-Lengt h: 441..
0480 0d 0a 66 65 65 64 62 61 63 6b 54 6f 70 69 63 3d ..feedba ckTopic=
0490 73 75 70 70 6f 72 74 2d 69 70 61 64 26 66 65 65 support- ipad&fee
04a0 64 62 61 63 6b 4e 61 6d 65 3d 53 63 6f 6f 74 65 dbackNam e=Scoote
04b0 72 26 66 72 6f 6d 41 64 64 72 3d 73 63 6f 6f 74 r&fromAd dr=scoot
04c0 65 72 39 39 39 25 34 30 67 6d 61 69 6c 2e 63 6f er999%40 gmail.co
HTTP Host (http.host), 25 bytes
Packets: 11678 Displayed: 12 Marked: 0 Load time: 0:01.286
Profile: wireshark101

above the Host field). Notice the name of the field in the Status Bar area

—http.request.method. We are looking for a POST request method in this field. We know the

field name and now we know the value we want to find.

In the display filter area, replace your current filter with http.request.method=="POST" and

click **Apply**[33].

Twelve packets should match your new filter.

Step 8: Scroll through the 12 packets to look for a reference to ***extras.sfgate.com*** in your **Host** column. That's the server on which the user posted the message about iPad support.

You should be looking at frame 10,022. Look through the Packet Bytes pane to read the message that

was posted. You should see the name of the submitter too—Scooter. You could also see this

information at the end of the HTTP section in the Packet Details pane (see the **[truncated]** section).

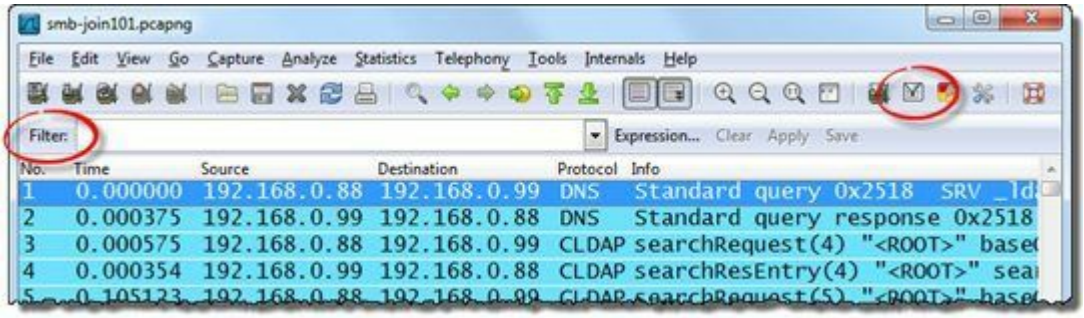
Step 9: [Lab Clean-up] Right-click on your new **Host** column and select **Hide Column**. If you want to use this column again later, you can right-click on any column heading and select your **Host** column

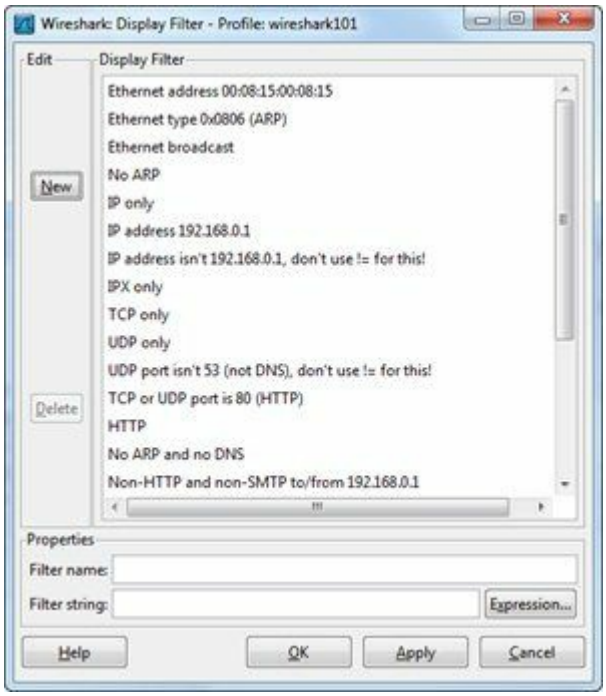
from the **Display Columns** list.

Click the **Clear** button to remove your display filter.

Practice with Wireshark's display filters to extract just the traffic of interest. Keep reading through

this chapter to learn various tips and tricks for display filtering.


smb-join101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Info
1 0.000000 192.168.0.88 192.168.0.99 DNS Standard query 0x2518 SRV _ld
2 0.000375 192.168.0.99 192.168.0.88 DNS Standard query response 0x2518
3 0.000575 192.168.0.88 192.168.0.99 CLDAP searchRequest(4) "<ROOT>" base
4 0.000354 192.168.0.99 192.168.0.88 CLDAP searchResEntry(4) "<ROOT>" sea



TIP

3.2. Edit and Use the Default Display Filters

You don't need to start from scratch. Wireshark includes 15 default display filters that you can use as

a reference to make new display filters. Add to these default display filters to create a more efficient

analysis system. You can either click the **Filter** button (to the left of the display filter area) or click on the **Display Filter** button (on the main toolbar) to open your display filters window. Both options are

circled in Figure 63.

Figure 63. The Filter label is actually a button—click on it to create, view, edit, or use saved display filters. [smb-join101.pcapng]

Figure 64 shows the default display filter list. These filters can be applied by simply selecting one of

the listed display filters and clicking **OK**.

Figure 64. You can streamline the default filter set by removing display filters you won't use.

Be careful before using a default display filter. The Ethernet and IP host filters have values that likely

do not match your network. You must edit these filters or use these filters as a "seed" to create your own set of Ethernet or IP address filters. You will use this technique in Lab 16.

To quickly apply more complex filters to your traffic, you can easily add to this list of saved display

filters.

Display filters are saved in a file called dfilters. It is just a text file and you can use any text

editor to edit the file (to add filters, delete filters, or rearrange filters for example). To find out

where your dfilters file is, first look at the name of the profile in which you are working. The

current profile name is shown on the right side of the Status Bar. If this area indicates you are

*in your "Default" profile, select **Help | About Wireshark | Folders** and double-click the*

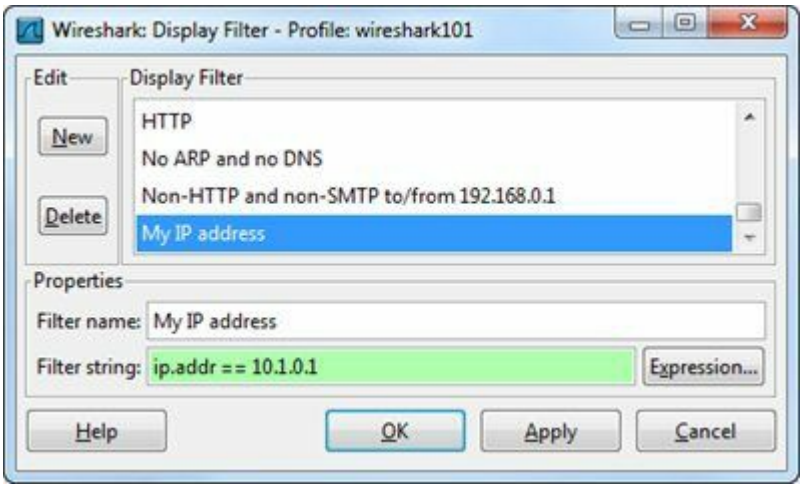
Personal Configuration folder hyperlink. The dfilters file is in this directory.

If you are using a different profile, follow the same steps to open your Personal Configuration

folder, but look for a profiles directory. There will be a subdirectory under profiles that is

named for each available profile. Look inside the appropriate profile directory to find the

dfilters file.



Lab 16: Use a Default Filter as a "Seed" for a New Filter

You can use the default display filters as a template to create and save new custom display filters.

This method helps you remember the display filter syntax and ensures that the syntax is correct. We

will create a display filter for all traffic to or from your IP address.

Step 1: Use the command-line tools ***ipconfig*** or ***ifconfig*** to obtain your IP address.

Step 2: Click the **Filter** button (to the left of the display filter area) to open the Display Filter window.

Step 3: Select the **IP address 192.168.0.1** default display filter and then click the **New** button. This creates a new copy of that default display filter and places it at the bottom of the display filter list. If

you don't click the **New** button, you will be editing the highlighted default filter.

Step 4: Scroll down to the bottom of the filter list and select this new copy of the **IP address**

192.168.0.1 filter. Change the filter name to " **My IP Address**" and replace 192.168.0.1 with your IP

address in the Filter string area. We used the IP address 10.1.0.1 in our example below.

Step 5: Click **OK** to save your new display filter and close the Display Filter window. You now

should see your new filter at the end of the display filter list. Wireshark automatically places your new

filter in the display filter area. If you don't want to use this filter right now, click the **Clear** button.

Spend some time creating a set of filters based on your Wireshark system's IP address and MAC

address (an Ethernet address filter). You might want to delete default filters that you do not need, for

example, if you plan to type the display filter for TCP only traffic (tcp), you can delete this filter. If

you never plan on using one of the display filters (IPX only, perhaps), delete it. Keep your filter list as

clean as possible.

3.3. Filter Properly on HTTP Traffic

Being able to properly filter on browsing sessions is important when you are troubleshooting your own

web browsing session or helping determine why the company web site loads slowly. Don't make the

most common mistake of all—using an application name in your filter.

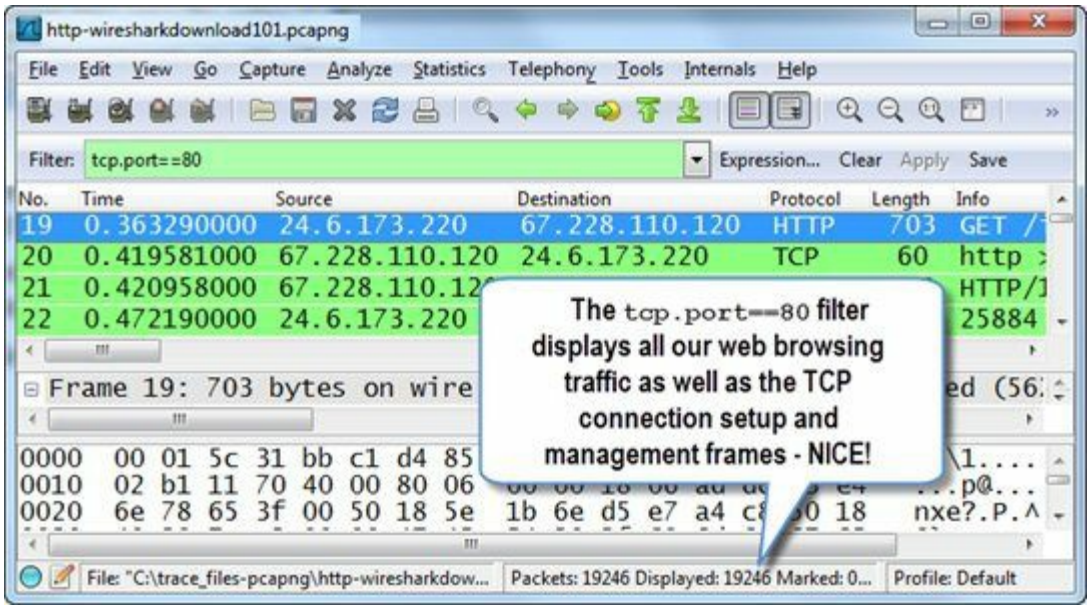
There are two methods used to filter on HTTP traffic.

http

tcp.port==xx (where xx denotes the HTTP port in use)

The second filter method is more effective. Let's examine why by comparing the use of each filter on

a trace file of a web browsing session.


http-wiresharkdownload101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: tcp.port==80
Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
19 0.363290000 24.6.173.220 67.228.110.120 HTTP 703 GET /
20 0.419581000 67.228.110.120 24.6.173.220 TCP 60 http
21 0.420958000 67.228.110.12 HTTP/1
22 0.472190000 24.6.173.220 25884
Frame 19: 703 bytes on wire
0000 00 01 5c 31 bb c1 d4 85
0010 02 b1 11 70 40 00 80 06
0020 6e 78 65 3f 00 50 18 5e
The tcp.port==80 filter displays all our web browsing traffic as well as the TCP connection setup and management frames - NICE!
File: "C:\trace_files-pcapng\http-wiresharkdow...
Packets: 19246 Displayed: 19246 Marked: 0...
Profile: Default

Test an Application Filter Based on a TCP Port Number

First let's open *http-wiresharkdownload101.pcapng*. This trace file contains a connection to

www.wireshark.org and a request to download a copy of Wireshark. We applied the tcp.port==80

display filter and find that, indeed, all of the packets match our filter, as shown in Figure 65. That's

good because that's all we have in the trace file.

Figure 65. Our port number-based filter displays all the packets in this wireshark.org browsing session. [http–

wiresharkdownload101.pcapng]

Look closely at the **Protocol** column of packet 20 in Figure 65 (also shown below).

Notice that Wireshark indicates this is a TCP packet, not an HTTP packet. Wireshark doesn't see any

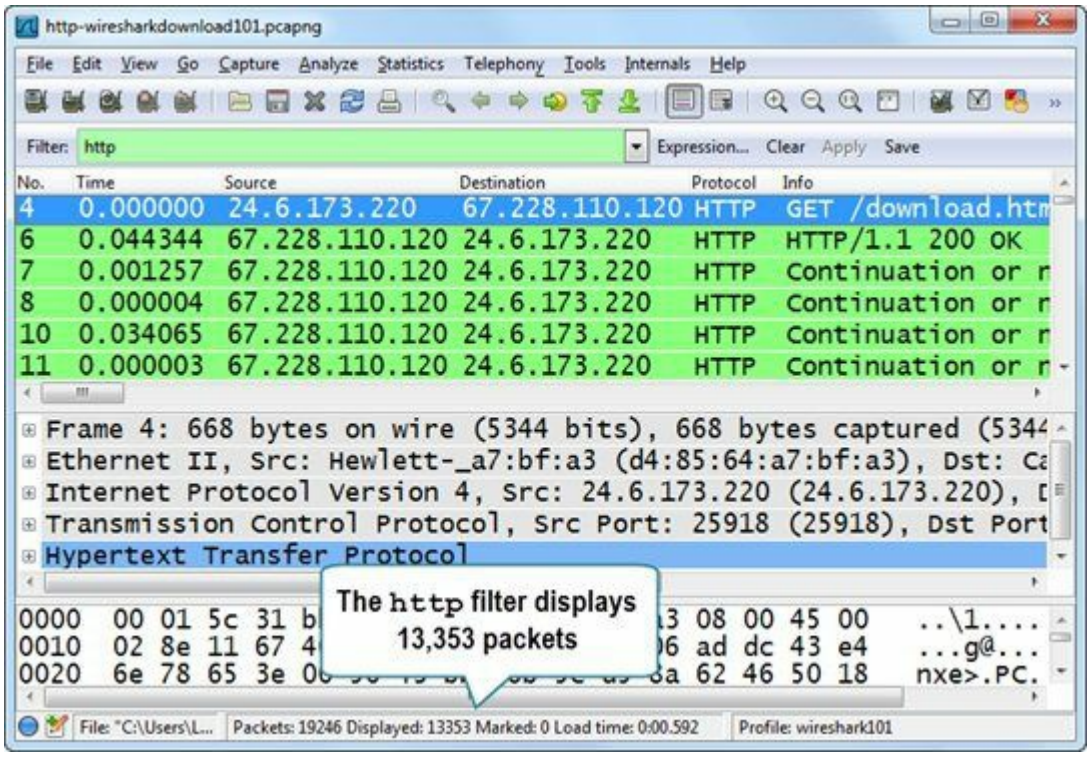
HTTP commands or responses in the packet so the HTTP dissector wasn't applied to the packet. It's

just a TCP packet (TCP ACKs, FINs, RSTs, and the three-way TCP handshake are simply listed as

TCP).

If you want to see the TCP connection establishment, maintenance and teardown packets, this is the

filter to use (and you always want to see those TCP packets, by the way).


http-wiresharkdownload101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: http
Expression... Clear Apply Save
No. Time Source Destination Protocol Info
4 0.000000 24.6.173.220 67.228.110.120 HTTP GET /download.htm
6 0.044344 67.228.110.120 24.6.173.220 HTTP HTTP/1.1 200 OK
7 0.001257 67.228.110.120 24.6.173.220 HTTP Continuation or r
8 0.000004 67.228.110.120 24.6.173.220 HTTP Continuation or r
10 0.034065 67.228.110.120 24.6.173.220 HTTP Continuation or r
11 0.000003 67.228.110.120 24.6.173.220 HTTP Continuation or r
Frame 4: 668 bytes on wire (5344 bits), 668 bytes captured (5344
Ethernet II, Src: Hewlett-_a7:bf:a3 (d4:85:64:a7:bf:a3), Dst: Ca
Internet Protocol Version 4, Src: 24.6.173.220 (24.6.173.220), D
Transmission Control Protocol, Src Port: 25918 (25918), Dst Port
Hypertext Transfer Protocol
The http filter displays 13,353 packets
0000 00 01 5c 31 b
0010 02 8e 11 67 4
0020 6e 78 65 3e 0
3 08 00 45 00 ..\1....
6 ad dc 43 e4 ...g@...
8a 62 46 50 18 nxe>.PC.
File: "C:\Users\L... Packets: 19246 Displayed: 13353 Marked: 0 Load time: 0:00.592 Profile: wireshark101

TIP

Be Cautious Using a TCP-based Application Name Filter

Now let's see what happened when we placed the http filter on the traffic. In Figure 66, you can see

that Wireshark is displaying 13,353 packets. Those are the packets that contain HTTP in the **Protocol**

column.

Note: If you see only 12 frames, your TCP preference is set to reassemble TCP streams. Review Lab 6

to properly configure Wireshark for this lab.

Figure 66. The http ilter does not show the TCP handshake, ACKs, or connection teardown process. [http–

wiresharkdownload101.pcapng]

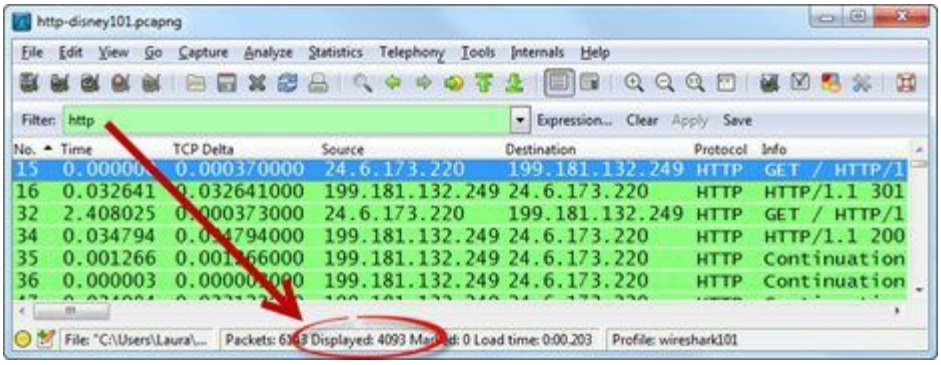
This is an incomplete picture of the web browsing session and we wouldn't be able to detect TCP

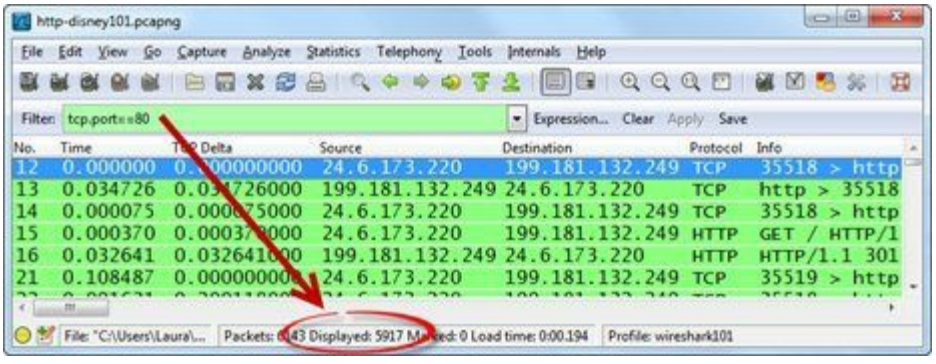
errors using this http filter. It is always better to use a port number filter on applications that use

TCP.

Unfortunately, Wireshark's default filter for HTTP traffic is simply http. Consider editing this

default filter to look for HTTP traffic based on a port number.




http-disney101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: tcp.port==80
Expression... Clear Apply Save
No. Time Source Destination Protocol Info
12 0.000000 24.6.173.220 199.181.132.249 TCP 35518 > http
13 0.034726 199.181.132.249 24.6.173.220 TCP http > 35518
14 0.000075 24.6.173.220 199.181.132.249 TCP 35518 > http
15 0.000370 24.6.173.220 199.181.132.249 HTTP GET / HTTP/1
16 0.032641 199.181.132.249 24.6.173.220 HTTP HTTP/1.1 301
21 0.108487 24.6.173.220 199.181.132.249 TCP 35519 > http
Profile: wireshark101

Lab 17: Filter on HTTP Traffic the Right Way

This is a quick lab. We will just compare the results from applying two different display filters to the

traffic. We will use http and then we will replace it with the proper filter for this web browsing

traffic.

Step 1: Open ***http-disney101.pcapng***. If you still have a filter applied from following along with the earlier section, simply click the **Clear** button to remove it.

Step 2: Apply an **http** filter. How many frames matched your filter? You should see 4,093 frames. If 205 frames are displayed, your TCP preference is set to reassemble TCP streams. Follow the

instructions in Lab 6 to disable this TCP preference setting.

Step 3: Replace your filter with **tcp.port==80** and click **Apply**. How many packets matched your filter now? (5,917 packets?) That's much better—you are seeing the full picture now.

Scroll through the trace file with this new filter in place. Notice the **Protocol** column indicates that

many of the packets were TCP, not HTTP. Wireshark classifies all the TCP handshake packets and

TCP ACK packets as simply "TCP." We want to see these packets because we want to analyze the

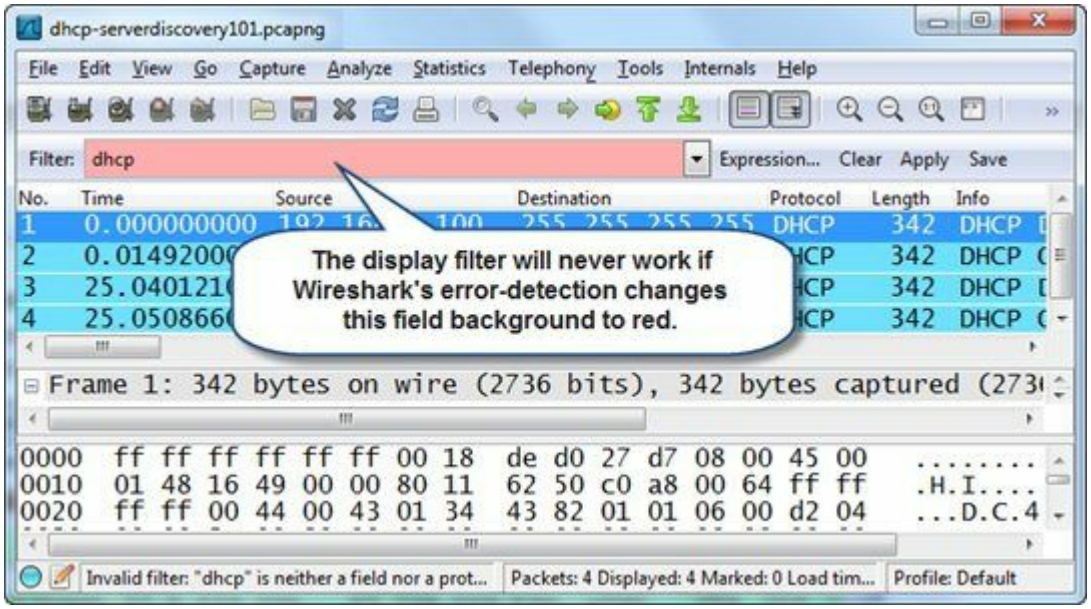
entire web browsing session, including the connection establishment process and acknowledgments.

Step 4: [Lab Clean-up] Click the **Clear** button to remove your display filter before continuing.

Always try to build application display filters based on port numbers. Although Wireshark's display

filtering mechanism understands various application names, you won't get a complete picture if you

use application names in your filters.


dhcp-serverdiscovery101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: dhcp
Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
1 0.000000000 DHCP 342 DHCP
2 0.0149200 HCP 342 DHCP
3 25.040121 HCP 342 DHCP
4 25.050866 HCP 342 DHCP
The display filter will never work if Wireshark's error-detection changes this field background to red.
Frame 1: 342 bytes on wire (2736 bits), 342 bytes captured (273
0000 ff ff ff ff ff ff 00 18 de d0 27 d7 08 00 45 00 ....'...E.
0010 01 48 16 49 00 00 80 11 62 50 c0 a8 00 64 ff ff .H.I.... bP...d..
0020 ff ff 00 44 00 43 01 34 43 82 01 01 06 00 d2 04 ...D.C.4 C.......
Invalid filter: "dhcp" is neither a field nor a prot...
Packets: 4 Displayed: 4 Marked: 0 Load tim...
Profile: Default

3.4. Determine Why Your dhcp Display Filter

Doesn't Work

This catches everyone who doesn't have grey hair. We are so accustomed to talking about DHCP on an

IPv4 network without acknowledging that DHCP is based on BOOTP. You only have to learn this

frustrating rule once, thank goodness.

If you type just dhcp as your display filter, the display filter area turns red indicating a syntax

problem, as shown in Figure 67. (Color images are only available in eBook format.)

Figure 67. Since DHCPv4 is based on BOOTP, you must use bootp as your filter—dhcp won't work. [dhcp–

serverdiscovery101.pcapng]

Although the **Protocol** column indicates the packets are DHCP, this filter will not work because

DHCP is based on BOOTP (Bootstrap Protocol).

The correct display filter syntax is **bootp**.

If you want to display DHCPv6 traffic, however, you can use dhcpv6 (DHCPv6 is not based on

BOOTP).

3.5. Apply Display Filters based on an IP

Address, Range of Addresses, or Subnet

Instead of applying a capture filter (and possibly missing related traffic because it was tossed aside

during the capture process), use display filters to focus on someone's traffic. These IP address display

filters are probably the most widely used filters. There are many options available when you want to

see traffic to or from a specific IP address, range of addresses, or subnet.

Filter on Traffic to or from a Single IP Address or Host

We will use the field names ip.src, ip.dst, ip.host, and ip.addr for IPv4 traffic and

ipv6.src, ipv6.dst, ipv6.host, and ipv6.addr for IPv6 traffic. Note that when you click

on an IP address in the Packet Details pane, it will be called ip.src, ip.dst, ipv6.src, or

ipv6.dst. The field names ip.host and ipv6.host and ip.addr and ipv6.addr do not

exist in packets.

The ip.host and ipv6 host filters looks for any IPv4 or IPv6 addresses that resolve to a specific host

name in either the IPv4/IPv6 source address field or IPv4/IPv6 destination address field. The

ip.addr==[address] and ipv6.addr==[address] filters looks for specific IPv4/IPv6

addresses in either the IPv4/IPv6 source address field or IPv4/IPv6 destination address field.

Example: ip.addr==10.3.1.1

Display frames that have 10.3.1.1 in the IP source address field or the IP destination address field

Example: !ip.addr==10.3.1.1

Display all frames *except* frames that have 10.3.1.1 in the IP source address field or 10.3.1.1 in

the IP destination address field

Example: ipv6.addr==2406:da00:ff00::6b16:f02d

Display all frames to or from 2406:da00:ff00::6b16:f02d

Example: ip.src==10.3.1.1

Display traffic *from* 10.3.1.1

Example: ip.dst==10.3.1.1

Display traffic *to* 10.3.1.1

Example: ip.host==www.wireshark.org[34]

Display traffic to or from the IP address that resolves to *www.wireshark.org*

Filter on Traffic to or from a Range of Addresses

You can use the ip.addr or ipv6.addr filters with the > or < comparison operators and the

logical operator && (and) to look for packets that contain an address within a range.

Example: ip.addr > 10.3.0.1 && ip.addr < 10.3.0.5

Display traffic to or from 10.3.0.2, 10.3.0.3 or 10.3.0.4

Example: (ip.addr >= 10.3.0.1 && ip.addr <= 10.3.0.6) &&

!ip.addr==10.3.0.3

Display traffic to or from 10.3.0.1, 10.3.0.2, 10.3.0.4, 10.3.0.5 or 10.3.0.6—the IP address

10.3.0.3 is excluded from the range specified

Example: ipv6.addr >= fe80:: && ipv6.addr < fec0::

Display traffic to or from IPv6 addresses beginning with 0xfe80 thorough 0xfec0.

Filter on Traffic to or from an IP Subnet

You can define a subnet in CIDR (Classless Interdomain Routing) format with the ip.addr field name.

This format uses the IP address followed by a slash and a suffix that indicates the number of bits that

define the network portion of the IP address.

Example: ip.addr==10.3.0.0/16

Display traffic that contains an IP address starting with 10.3 in the source IP address field or

destination IP address field

Example: ip.addr==10.3.0.0/16 && !ip.addr==10.3.1.1

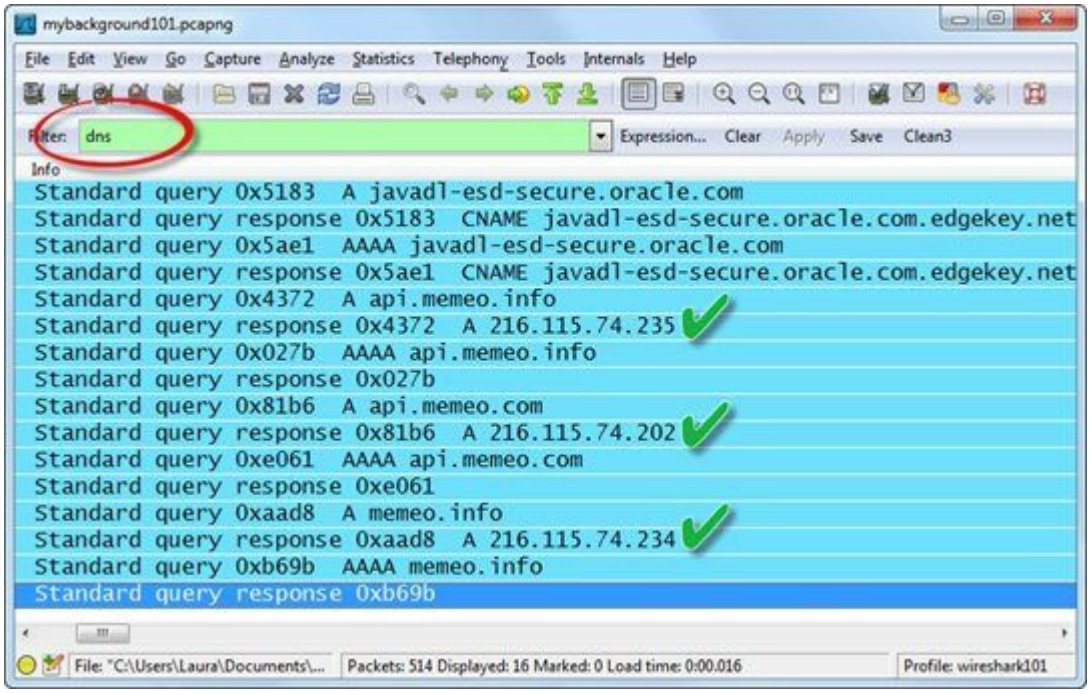
Display traffic that contains an IP address starting with 10.3 in the source IP address field or

destination IP address field *except* 10.3.1.1

Example: !ip.addr==10.3.0.0/16 && !ip.addr==10.2.0.0/16

Display all traffic except traffic that contains an IP address starting with 10.3 or 10.2 in the

source IP address field or destination IP address field


mybackground101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: dns
Expression... Clear Apply Save Clean3
Info
Standard query 0x5183 A javadl-esd-secure.oracle.com
Standard query response 0x5183 CNAME javadl-esd-secure.oracle.com.edgekey.net
Standard query 0x5ae1 AAAA javadl-esd-secure.oracle.com
Standard query response 0x5ae1 CNAME javadl-esd-secure.oracle.com.edgekey.net
Standard query 0x4372 A api.memeo.info
Standard query response 0x4372 A 216.115.74.235
Standard query 0x027b AAAA api.memeo.info
Standard query response 0x027b
Standard query 0x81b6 A api.memeo.com
Standard query response 0x81b6 A 216.115.74.202
Standard query 0xe061 AAAA api.memeo.com
Standard query response 0xe061
Standard query 0xaad8 A memeo.info
Standard query response 0xaad8 A 216.115.74.234
Standard query 0xb69b AAAA memeo.info
Standard query response 0xb69b
File: "C:\Users\Laura\Documents\...
Packets: 514 Displayed: 16 Marked: 0 Load time: 0:00.016
Profile: wireshark101

Lab 18: Filter on Traffic to or from Online Backup Subnets

In this lab, we will apply a subnet display filter to examine traffic to or from a backup server for

Memeo which offers an online backup product. This traffic runs in the background, constantly

checking in with the server.

Step 1: Open ***mybackground101.pcapng***.

Step 2: Apply a display filter for DNS traffic. Note the IP addresses supplied for the *api.memeo.info*, *api.memeo.com*, and *memeo.info* hosts. They all begin with 216.115.74. We will build a subnet filter based on these starting bytes. We scrolled to the right in the image below to see more of the **Info**

column.

Step 3: Apply a display filter for **ip.addr==216.115.74.0/24** to view all traffic to or from any

of the hosts on this subnet. There should be 51 packets that match your display filter.

Step 4: [Lab Clean-up] Click the **Clear** button to remove your display filter before continuing.

If you want to filter the traffic to or from the Memeo subnets *out* of view, apply the same filter, but

precede it with the not ("!") operator)—!ip.addr==216.115.74.0/24.

3.6. Quickly Filter on a Field in a Packet

When you're looking for all traffic that contains a particular characteristic, you can go the long way or

take the short path. Unless you are training for a marathon, take the short path. Although you can type

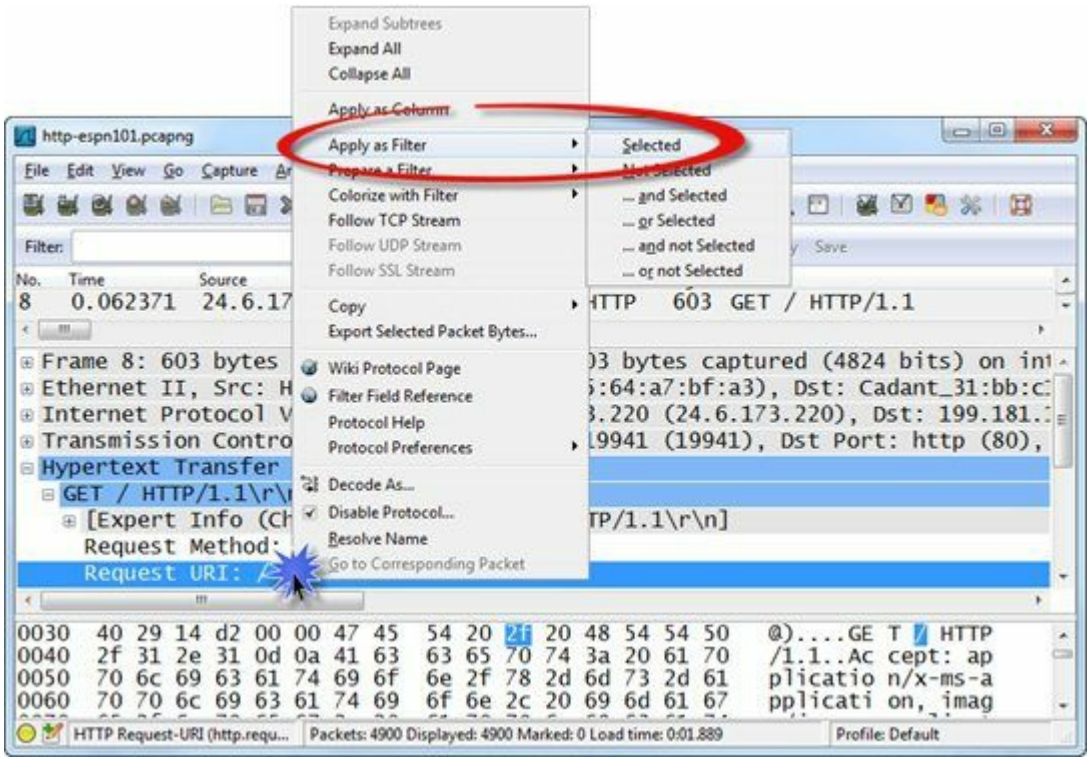
display filters and click **Apply**, using the right-click method is a faster way to build and apply display

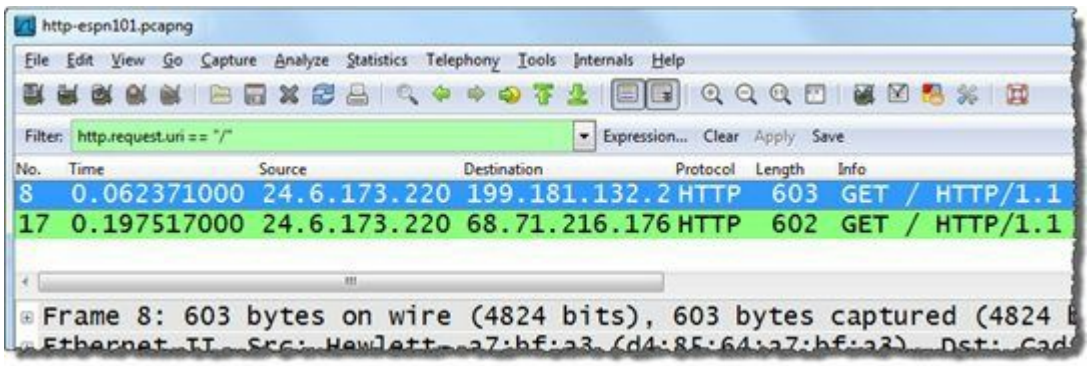
filters.

You can right-click on any field or characteristic in a packet and select either **Apply as Filter** (which

creates and applies the filter right away) or **Prepare a Filter** (which puts the new filter in the display

filter area, but does not automatically apply it to the trace file).


Expand Subtrees
Expand All
Collapse All
Apply as Column
Apply as Filter
Prepare a Filter
Colorize with Filter
Follow TCP Stream
Follow UDP Stream
Follow SSL Stream
Copy
Export Selected Packet Bytes...
Wiki Protocol Page
Filter Field Reference
Protocol Help
Protocol Preferences
Decode As...
Disable Protocol...
Resolve Name
Go to Corresponding Packet
Selected
Not Selected
... and Selected
... or Selected
... and not Selected
... or not Selected
http-espn101.pcapng
File Edit View Go Capture
Filter:
No. Time Source
8 0.062371 24.6.17
HTTP 603 GET / HTTP/1.1
Frame 8: 603 bytes
Ethernet II, Src: H
Internet Protocol V
Transmission Contro
Hypertext Transfer
GET / HTTP/1.1\r\
[Expert Info (CH
Request Method:
Request URI:
03 bytes captured (4824 bits) on int
:64:a7:bf:a3), Dst: Cadant_31:bb:c
.220 (24.6.173.220), Dst: 199.181.
19941 (19941), Dst Port: http (80),
TP/1.1\r\n]
0030 40 29 14 d2 00 00 47 45 54 20 2f 20 48 54 54 50 @)....GE T / HTTP
0040 2f 31 2e 31 0d 0a 41 63 63 65 70 74 3a 20 61 70 /1.1..Ac cept: ap
0050 70 6c 69 63 61 74 69 6f 6e 2f 78 2d 6d 73 2d 61 plicatio n/x-ms-a
0060 70 70 6c 69 63 61 74 69 6f 6e 2c 20 69 6d 61 67 pplicati on, imag
HTTP Request-URI (http.requ...
Packets: 4900 Displayed: 4900 Marked: 0 Load time: 0:01.889
Profile: Default


http-espn101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: http.request.uri == "/"
Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
8 0.062371000 24.6.173.220 199.181.132.2 HTTP 603 GET / HTTP/1.1
17 0.197517000 24.6.173.220 68.71.216.176 HTTP 602 GET / HTTP/1.1
Frame 8: 603 bytes on wire (4824 bits), 603 bytes captured (4824

Work Quickly—Use Right-Click | Apply as Filter

For example, in Figure 68 we opened *http-espn101.pcapng*. In the Packet Details pane of frame 8, we

expanded the HTTP section and right-clicked on the **Request URI** line that indicates the user wants to

download the main page of a web site (/). We selected **Apply as Filter | Selected**.

Figure 68. Use the right-click method to quickly apply a filter based on content in a field or on a packet characteristic. [http-espn101.pcapng]

Wireshark creates the proper display filter (http.request.uri=="/") and applies it to the trace

file. We now have two packets displayed. It appears this user is requesting the main page from two

different IP addresses, as shown in Figure 69.

Figure 69. Two packets matched our filter for http.request.uri=="/". [http-espn101.pcapng]

If you want to exclude these types of HTTP requests from view, simply add an exclamation point or

the word *not* before the filter. This is called an *exclusion filter*. You can also create this exclusion filter by right-clicking on a GET request for the default page and selecting **Apply as Filter | Not**

Selected[35].

Using this exclusion filter on the *http-espn101.pcapng* trace file would display 4,898 packets, but it

would not be a very interesting set of packets to wade through. Consider expanding this filter to

indicate that you are interested in the other HTTP GET requests.

Leaving your exclusion filter in the display filter area, locate an HTTP GET request packet (packet 70,

for example).

Expand the HTTP section so you can see the Request Method: GET request line. Right-click this line

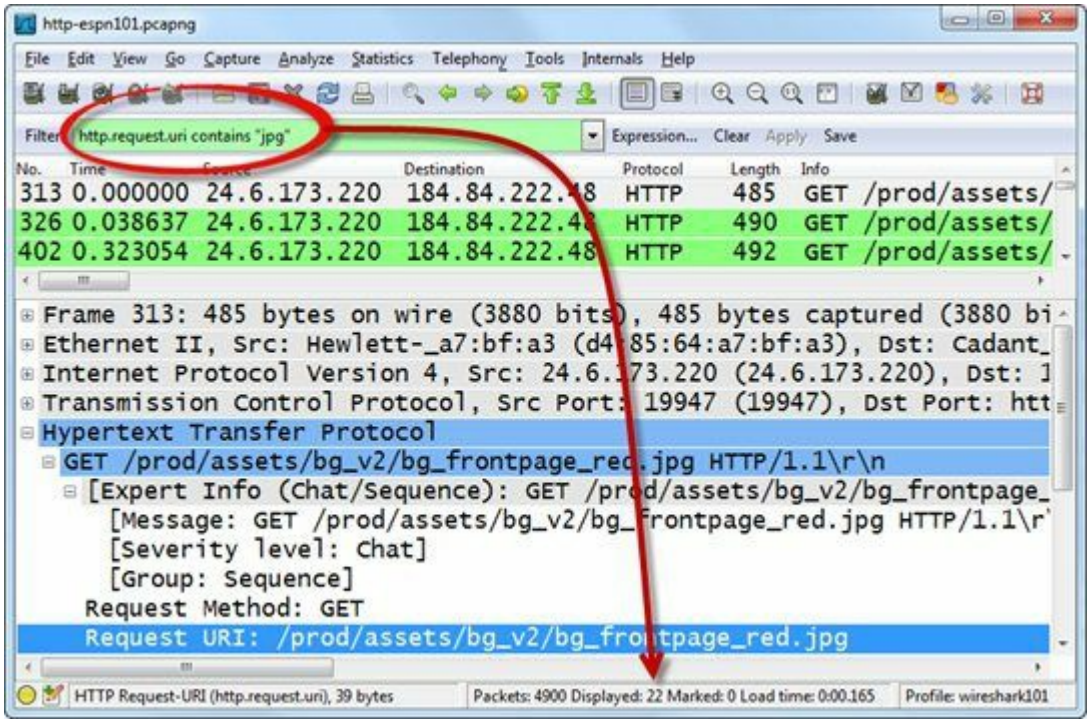
and select **Apply as Filter**. This time you are going to add on to the existing filter using the **...and**

Selected option.

The filter options beginning with ... are used to add on to the filter shown in the display filter area.

After selecting **... and Selected**, your display filter should look as follows. Now 146 packets match

your filter. You are looking at all the HTTP GET requests *except* for the default page requests (/).


http-espn101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: http.request.uri contains "jpg"
Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
313 0.000000 24.6.173.220 184.84.222.48 HTTP 485 GET /prod/assets/
326 0.038637 24.6.173.220 184.84.222.48 HTTP 490 GET /prod/assets/
402 0.323054 24.6.173.220 184.84.222.48 HTTP 492 GET /prod/assets/
Frame 313: 485 bytes on wire (3880 bits), 485 bytes captured (3880 bi
Ethernet II, Src: Hewlett-_a7:bf:a3 (d4:85:64:a7:bf:a3), Dst: Cadant_
Internet Protocol Version 4, Src: 24.6.173.220 (24.6.173.220), Dst: 1
Transmission Control Protocol, Src Port: 19947 (19947), Dst Port: htt
Hypertext Transfer Protocol
GET /prod/assets/bg_v2/bg_frontpage_red.jpg HTTP/1.1\r\n
[Expert Info (Chat/Sequence): GET /prod/assets/bg_v2/bg_frontpage_
[Message: GET /prod/assets/bg_v2/bg_frontpage_red.jpg HTTP/1.1\r
[Severity level: Chat]
[Group: Sequence]
Request Method: GET
Request URI: /prod/assets/bg_v2/bg_frontpage_red.jpg
HTTP Request-URI (http.request.uri), 39 bytes
Packets: 4900 Displayed: 22 Marked: 0 Load time: 0:00.165
Profile: wireshark101

Be Creative with Right-Click | Prepare a Filter

Use **Prepare a filter** when you want to change the filter or check the syntax before it is applied. For

example, perhaps you want to know if anyone has made a request for a .jpg file. Right-click the

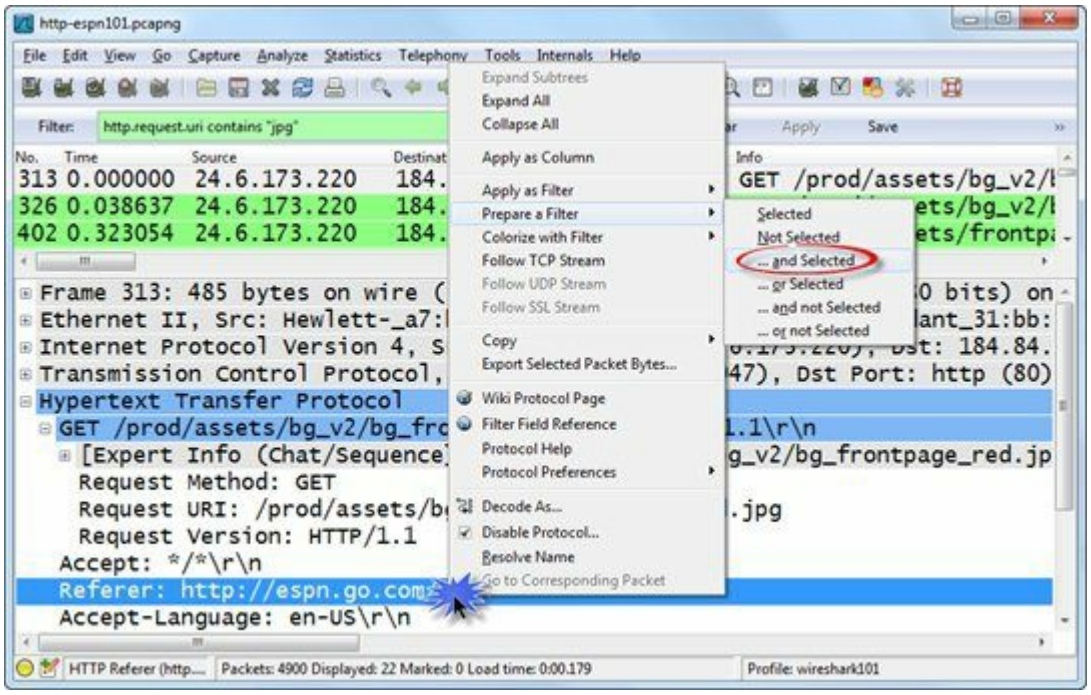
Request URI line in packet 70 of *http-espn101.pcapng* and select **Prepare a Filter | Selected**.

Wireshark places http.request.uri=="/prod/scripts/mbox.js" in the display filter

area, but it does not apply the filter to the traffic. Change the display filter to http.request.uri

contains "jpg" and click **Apply**. Twenty-two packets should match your new filter, as shown in Figure 70.

*Figure 70. After right-clicking on the Request URI line and selecting **Prepare a Filter**, change your filter to look for frames that contain "jpg" in this field. [http-espn101.pcapng]*



Right-Click Again to use the "..." Filter Enhancements

When you performed the right-click **Apply as Filter** and **Prepare a Filter** operations, you saw four

other filter options that begin with "...", as shown in Figure 71. In this example, we still have our

http.request.uri contains "jpg " filter and we also want to look for *go.espn.com* in the

Referer[36] line.

Any filter option that begins with "..." will be appended to the existing display filter.

Figure 71. Use the ... filter options to expand an existing display filter. [http-espn101.pcapng]

The following list demonstrates how the add-on filters can be used if we already have a

tcp.port==80 filter in place.

Right-click on Request Method: GET and choose **Selected**

Filter created: http.request.method == "GET"

This will replace the current display filter and display all HTTP packets that contain the GET

request method.

Right-click on Request Method: GET and choose **Not Selected**

Filter created: !(http.request.method == "GET")

This will replace the current display filter and display any packets *except* HTTP packets that

contain the HTTP GET request method.

Right-click on Request Method: GET and choose **... and Selected**

Filter created: (tcp.port==80) && (http.request.method == "GET")

This will display packets to or from port 80 that contain the HTTP GET request method.

Right-click on Request Method: GET and choose **... or Selected**

Filter created: (tcp.port==80) || (http.request.method == "GET")

This will display packets to or from port 80 as well as any HTTP packets that contain the GET

request method. For example, if your HTTP traffic uses port 81, you will still see all the HTTP

GET requests from that traffic.

Right-click on Request Method: GET and choose **... and Not Selected**

Filter created: (tcp.port==80) && !(http.request.method == "GET")

This will display all traffic to or from port 80, but not any HTTP packets on that port that contain

the GET request method.

Right-click on IP Source Address 10.2.2.2 and choose **... or Not Selected**

Filter created: (tcp.port==80) || !(ip.src==10.2.2.2)

This will display packets to or from port 80 or any traffic that is not from 10.2.2.2

*Watch out for the **...or Not Selected option**. Many times people use this by mistake when*

they want to add on to an exclusion filter (something that hides specific traffic types).

*For example, if you don't want to see ARP traffic or DNS traffic, using the **...or Not Selected***

option would create !arp || !dns. This filter would not do anything. DNS packets would be

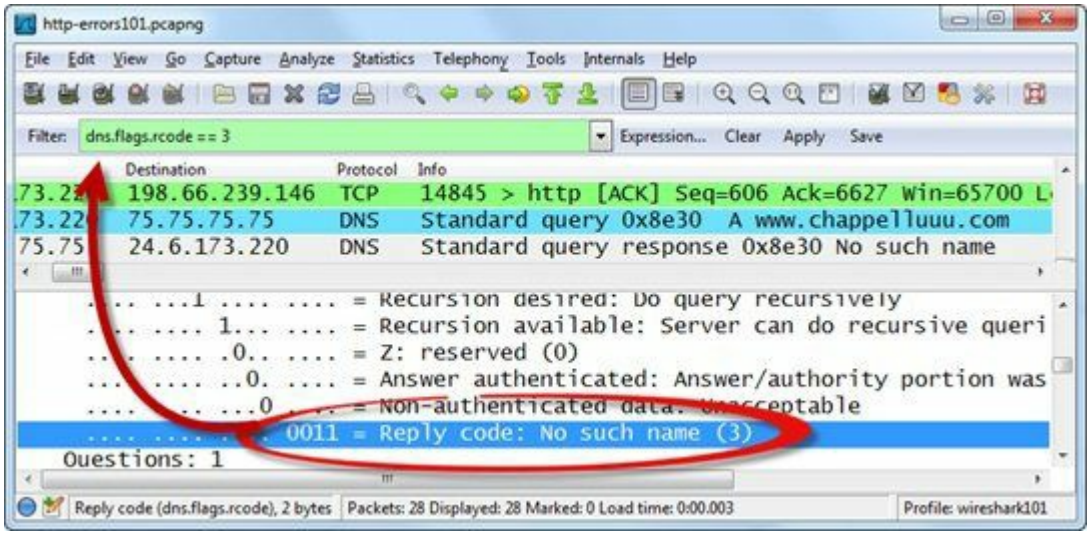
shown because they are not ARP packets (matching the first side of the or operator) and ARP

packets would be shown because they are not DNS packets (matching the second side of the

or operator).

*If you are trying to filter packets out of view, most likely you want the **...and Not Selected***

option.


http-errors101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: dns.flags.rcode == 3
Expression... Clear Apply Save
Destination Protocol Info
198.66.239.146 TCP 14845 > http [ACK] Seq=606 Ack=6627 Win=65700 L
75.75.75.75 DNS Standard query 0x8e30 A www.chappelluuu.com
24.6.173.220 DNS Standard query response 0x8e30 No such name
....1 .... = Recursion desired: Do query recursively
.... 1... .... = Recursion available: Server can do recursive queri
.... .0.. .... = Z: reserved (0)
....0. .... = Answer authenticated: Answer/authority portion was
....0 .... = Non-authenticated data: Unacceptable
.... 0011 = Reply code: No such name (3)
Questions: 1
Reply code (dns.flags.rcode), 2 bytes
Packets: 28 Displayed: 28 Marked: 0 Load time: 0:00.003
Profile: wireshark101

Lab 19: Filter on DNS Name Errors or HTTP 404 Responses

In this lab we will look for specific DNS or HTTP error responses using the right-click method. This is

a great filter that you may want to save.

Step 1: Open ***http-errors101.pcapng***. Scroll through and look at the **Info** column of the Packet List pane to see the problems in this web browsing session. If you applied a filter while following along in

the earlier section, clear it now.

Step 2: Click on **frame 18**. This is a DNS Name Error response. Expand the DNS subtrees so you can

see the fields inside the Flags section, as shown below. Right-click on the **Reply code: No such name**

(3) field and select **Prepare a Filter | Selected**. The first part of your filter appears in the filter area.

Step 3: Click on **frame 9**. This is an HTTP 404 Response. We will add on to our existing filter and

view it before applying it.

In frame 9, expand the **HTTP section of the packet**. Right-click on the **Status Code: 404** line, select **Prepare a Filter | ...or Selected**. Your display filter area should show (dns.flags.rcode==3)

|| (http.response.code==404).

Step 4: Click **Apply**. Three frames should match your filter.

Step 5: [Lab Clean-up] When you've finished looking through the frames that matched your filter,

click the **Clear** button to remove the filter. If you need to use this filter again soon, click the arrow to the right of the filter area. We set Wireshark to remember the last 30 display filters in Lab 6.

This is a great filter, but it can be improved by looking for all DNS or HTTP error reply codes

(dns.flags.rcode != 0 or http.response.code > 399). Note that the display filter

area turns yellow because of the "!=", but this filter will actually work fine.

3.7. Filter on a Single TCP or UDP

Conversation

When you want to analyze communication between a client application and a server process, you are

looking for a "conversation." That conversation is based on the IP addresses and port numbers of the

client application and the server process. Often your trace file will contain hundreds of conversations.

Knowing how to quickly locate and filter on the conversation you are interested in will move your

analysis process forward quickly.

The following lists four ways to extract a single TCP or UDP conversation from a trace file:

Extract a UDP/TCP conversation by right-clicking a UDP or TCP packet in the Packet List pane

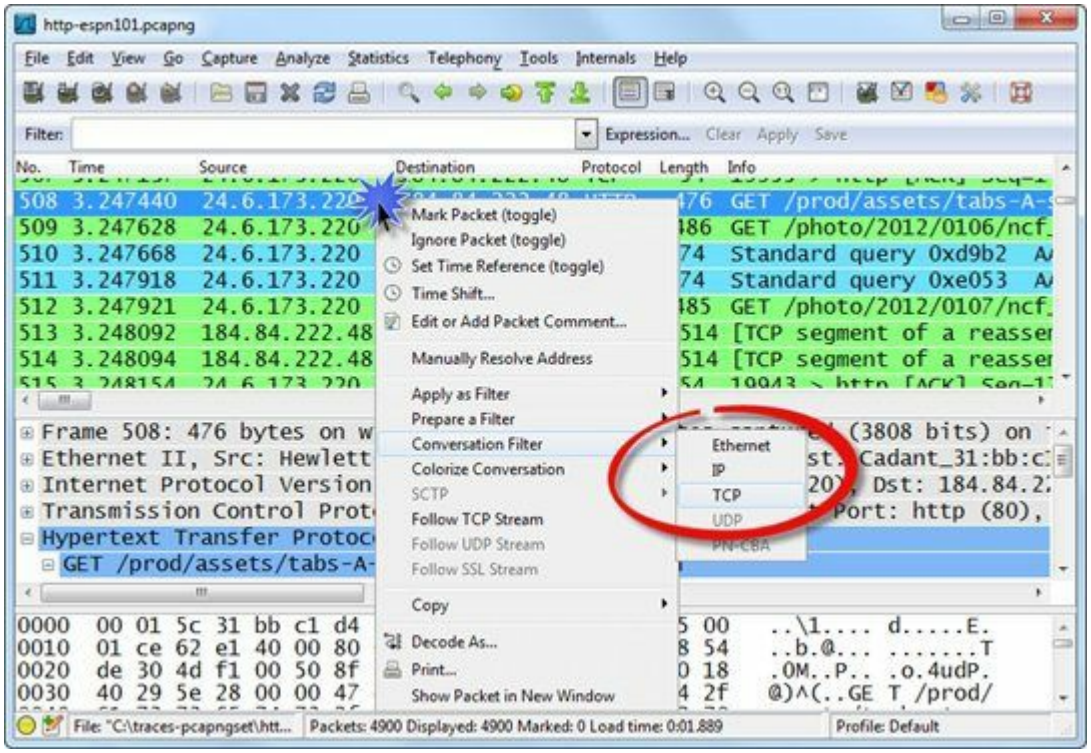
and selecting **Conversation Filter | [TCP|UDP]**.

Extract a UDP/TCP conversation by right-clicking a UDP or TCP packet in the Packet List pane

and selecting **Follow [TCP|UDP] Stream**.

Extract a conversation from Wireshark **Statistics | Conversations.**

Extract a TCP conversation based on the Stream index number (in the TCP header).



Use Right-Click to Filter on a Conversation

When you browse through packets and you want to quickly filter on a TCP conversation, right-click on

any packet in the Packet List pane and select **Conversation Filter | TCP**, as shown in Figure 72.

Figure 72. Right-click on a packet to filter on a specific conversation. [http-espn101.pcapng]

We right-clicked on **packet 508** in *http-espn101.pcapng* and selected **Conversation Filter | TCP**.

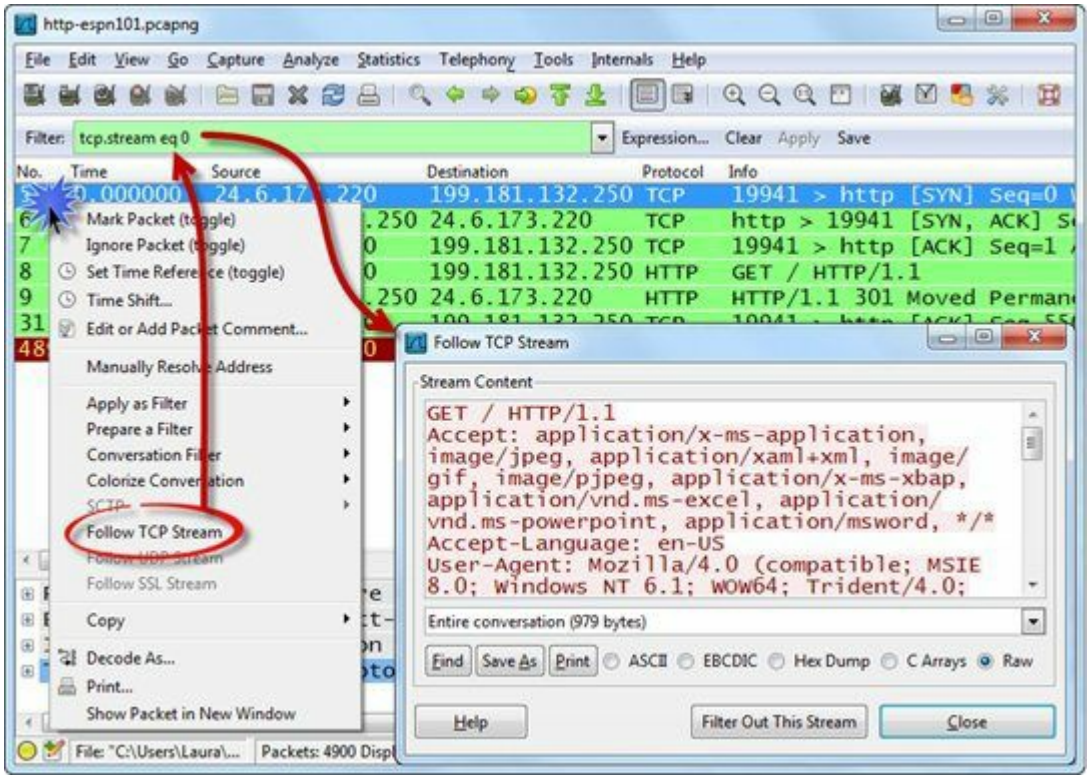
Wireshark created and applied the following display filter to the traffic:

(ip.addr eq 24.6.173.220 and ip.addr eq 184.84.222.48) and (tcp.port

eq 19953 and tcp.port eq 80)

You can use the same method to filter on a conversation based on IP addresses, Ethernet addresses, or

UDP address/port number combinations.


http-espn101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: tcp.stream eq 0
Expression... Clear Apply Save
No. Time Source Destination Protocol Info
199.181.132.250 TCP 19941 > http [SYN] Seq=0
24.6.173.220 TCP http > 19941 [SYN, ACK] S
199.181.132.250 TCP 19941 > http [ACK] Seq=1
199.181.132.250 HTTP GET / HTTP/1.1
24.6.173.220 HTTP HTTP/1.1 301 Moved Permane
Mark Packet (toggle)
Ignore Packet (toggle)
Set Time Reference (toggle)
Time Shift...
Edit or Add Packet Comment...
Manually Resolve Address
Apply as Filter
Prepare a Filter
Conversation Filter
Colorize Conversation
SCTP
Follow TCP Stream
Follow UDP Stream
Follow SSL Stream
Copy
Decode As...
Print...
Show Packet in New Window
Follow TCP Stream
Stream Content
GET / HTTP/1.1
Accept: application/x-ms-application, image/jpeg, application/xaml+xml, image/gif, image/pjpeg, application/x-ms-xbap, application/vnd.ms-excel, application/vnd.ms-powerpoint, application/msword, */*
Accept-Language: en-US
User-Agent: Mozilla/4.0 (compatible; MSIE 8.0; Windows NT 6.1; WOW64; Trident/4.0;
Entire conversation (979 bytes)
Find Save As Print ASCII EBCDIC Hex Dump C Arrays Raw
Help Filter Out This Stream Close
File: "C:\Users\Laura\... Packets: 4900

Use Right-Click to Follow a Stream

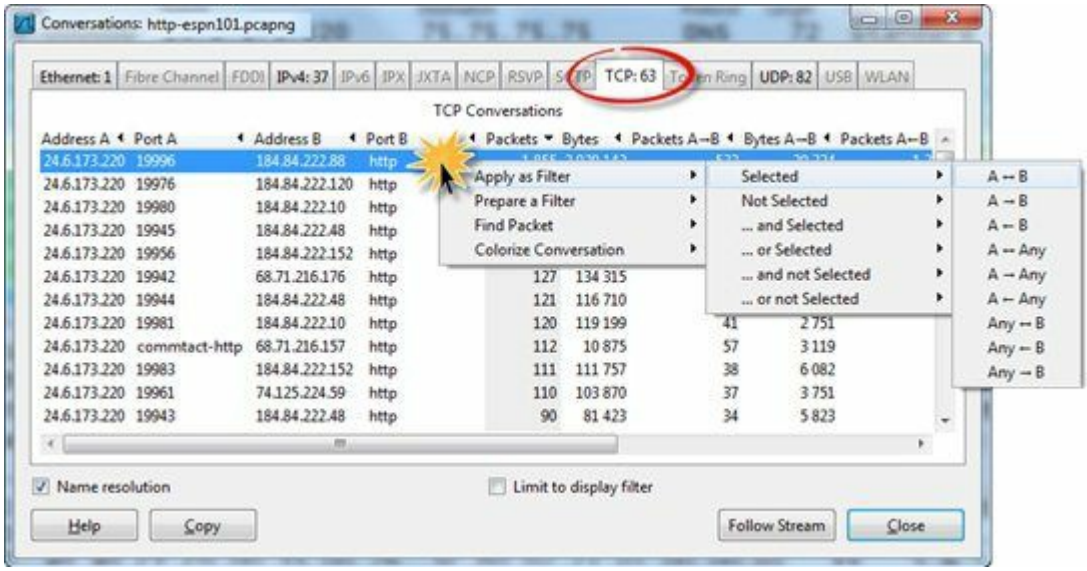
To view the application commands and data exchanged in a conversation as well as apply a

conversation filter, right-click on any packet in the Packet List pane and select **Follow [UDP|TCP]**

Stream, as shown in Figure 73. If you select **Follow UDP Stream**, the display filter will be based on the IP addresses and port numbers. If you select **Follow TCP Stream**, the display filter will be based

on the TCP Stream Index number.

*Figure 73. Right-click on a TCP or UDP packet in the Packet List pane and select **Follow [UDP|TCP] Stream**. This creates a conversation filter based on the selected packet while displaying the conversation in a separate window.*



TIP

Filter on a Conversation from Wireshark Statistics

Select **Statistics | Conversations** to view, sort, and quickly filter on a conversation. Click one of the

protocol tabs at the top of the Conversations window to select the conversation type in which you are

interested.

Right-click on a conversation line to select **Apply as Filter**, **Prepare a Filter**, **Find a Packet**, or **Colorize Conversation**.

When you select **Apply as Filter** or **Prepare a Filter**, some interesting options appear. In Figure 74, we selected **Statistics | Conversations** and sorted on the **Packets** column. Next, we right-clicked on the top conversation and saw the option to apply or prepare a filter using the standard options

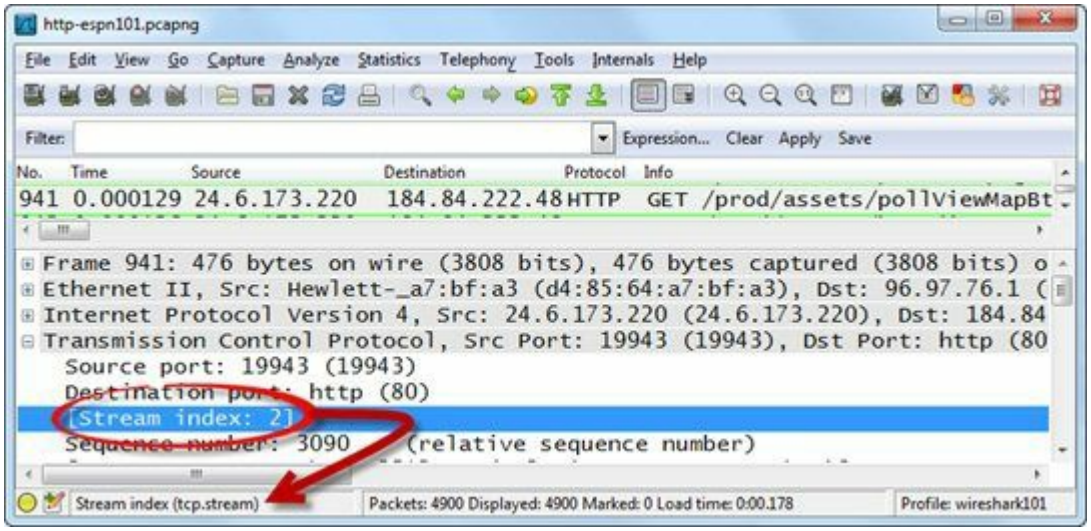
(**Selected**, **Not Selected**, etc.). We can also choose to define the direction or inclusion of "Any" in the filter.

Under the **UDP** and **TCP** tabs, the term "A" refers to both columns labeled with "A"—the **Address A** and **Port A** column (**ip.addr==24.6.173.220 && tcp.port==19996**).

*Figure 74. Right-click on a row and select **Apply as Filter** to view special options for conversation filtering. [http-espn101.pcapng]*

*You can perform the same basic steps from the **Statistics** | **Endpoints** window although you*

will not have the "A" and "B" designations available.


http-espn101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Info
941 0.000129 24.6.173.220 184.84.222.48 HTTP GET /prod/assets/pollViewMapBt
Frame 941: 476 bytes on wire (3808 bits), 476 bytes captured (3808 bits) o
Ethernet II, Src: Hewlett-_a7:bf:a3 (d4:85:64:a7:bf:a3), Dst: 96.97.76.1 (
Internet Protocol Version 4, Src: 24.6.173.220 (24.6.173.220), Dst: 184.84
Transmission Control Protocol, Src Port: 19943 (19943), Dst Port: http (80
Source port: 19943 (19943)
Destination port: http (80)
[Stream index: 2]
Sequence number: 3090 (relative sequence number)
Stream index (tcp.stream)
Packets: 4900 Displayed: 4900 Marked: 0 Load time: 0:00.178
Profile: wireshark101

TIP

Filter on a TCP Conversation Based on the Stream Index Field

In TCP headers, you can also right-click on the Stream Index field to create a TCP conversation filter.

In Figure 75, we expanded a TCP header to highlight and right-click on the Stream Index field and

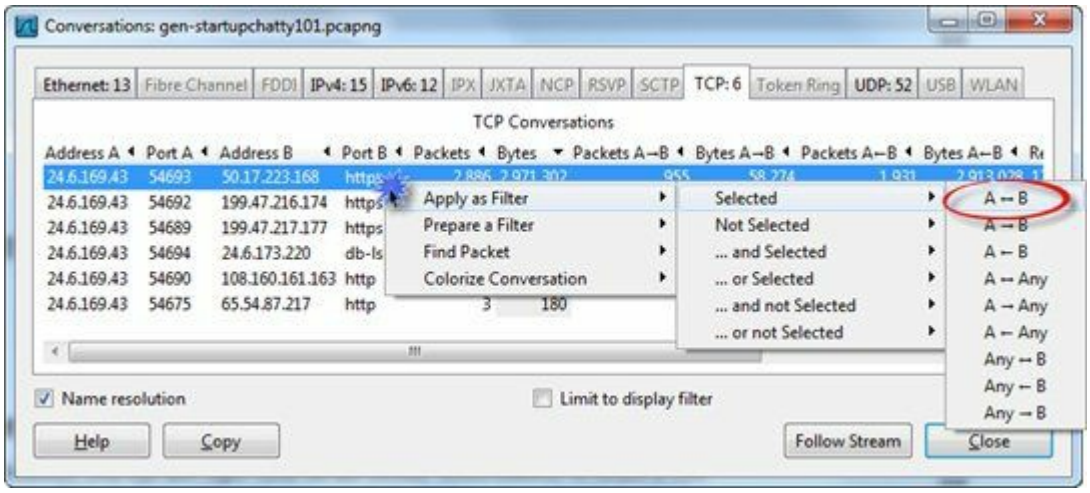
selected **Apply as Filter**, we can create a tcp.stream==2 conversation filter.

Figure 75. Wireshark gives each TCP conversation a unique Stream index number. [http–espn101.pcapng]

This TCP Stream index number can be a great help when you are working with a trace file

*that has many intertwined conversations. Right-click on this field and **Apply as Column**. Use*

*the values in your **TCP Stream index** column to easily identify separate conversations.*



Lab 20: Detect Background File Transfers on Startup

There may be a number of background processes that run when you start up your machine. Some of

these may update your virus detection mechanism, your operating system, or applications. In this lab,

you will detect and filter on the most active conversation of a host that is just starting up.

Step 1: Open ***gen-startupchatty101.pcapng***.

Step 2: Select **Statistics | Conversations | TCP** and sort by the **Bytes** column from high to low to locate the most active TCP conversation based on byte count.

Step 3: Right-click on the most active conversation and select **Apply as Filter | Selected | A <—> B**.

The Status Bar should indicate 2,886 packets matched your filter. The TCP peer in this conversation is

50.17.223.168.

We can see this is a Transport Layer Security (TLS) conversation.

Step 4: Frame 311 is the first packet in this conversation. Click the **Clear** button to remove your filter and look for a name resolution process before frame 311. Based on frames 309 and 310, this appears

to be a Dropbox server. The client must be checking in and downloading a file from their Dropbox

folder.

Step 5: [Lab Clean-up] Wireshark will keep display filters in place. Click the **Clear** button to remove any unwanted display filters.

You can use the right-click method to quickly apply filters directly from many Wireshark statistics

windows, including the Conversations, Endpoints, and Protocol Hierarchy windows.

3.8. Expand Display Filters with Multiple

Include and Exclude Conditions

There will be many times when you want to filter on the values in more than one field. For example,

you might be interested in seeing all packets that contain the command GET in the HTTP Request

Method field and ".exe" in the HTTP Request URI field. You should combine these two conditions

using a logical operator.

Use Logical Operators

Wireshark understands four logical operators. The next list provides examples of how Wireshark

logical operators can be used to expand your display filters by adding conditions.

&& or and

Example: ip.src==10.2.2.2 && tcp.port==80

View all IPv4 traffic from 10.2.2.2 that is to or from port 80

|| or or

Example: tcp.port==80 || tcp.port==443

View all TCP traffic to or from ports 80 or 443

! or not

Example: !arp

View all traffic *except* ARP traffic

!= or ne

Example: tcp.flags.syn != 1

View TCP frames that do not have the TCP SYN flag (synchronize sequence numbers) set to 1

Why didn't my ip.addr != filter work?

People often get stuck on the != operator. Here are some tips on how Wireshark interprets this

operator.

Incorrect: ip.addr != 10.2.2.2

Display packets that do not have 10.2.2.2 in the IP source address field *or* IP destination address field.

If an address other than 10.2.2.2 is contained in the source *or* destination IP address fields, the packet will be displayed. This uses an implied *or* and will not filter out any packets.

Correct: !ip.addr == 10.2.2.2

Display packets that do not have 10.2.2.2 in the IP source address field and also does not have 10.2.2.2

in the destination address field. This is the proper filter syntax when excluding traffic to or from a

specific IP address.

Why didn't my !tcp.flags.syn==1 filter work?

Just when you begin to embrace the process of splitting up the "!" from the "="... something isn't quite right. If you were trying to display all TCP packets that did not have the SYN bit set to 1, this

filter will not work.

Incorrect: !tcp.flags.syn==1

This filter is interpreted as "display all packets that do not have a TCP SYN bit set to 1." Other

protocol packets, such as UDP and ARP packets will match this filter, after all, they don't have a TCP

SYN bit set to 1.

Correct: tcp.flags.syn !=1

This filter will only display TCP packets that contain a SYN set to 0.

Don't be afraid to use the != operator when you know there is only one field that matches

your filter field name. Sometimes this is the best filter operator to use.

3.9. Use Parentheses to Change Filter

Meaning

Be aware how parentheses can change the meaning of your filters when you create and add conditions

to your filter.

For example, consider the following display filters:

(tcp.port==80 && ip.src==10.2.2.2) || tcp.flags.syn==1

tcp.port==80 && (ip.src==10.2.2.2 || tcp.flags.syn==1)

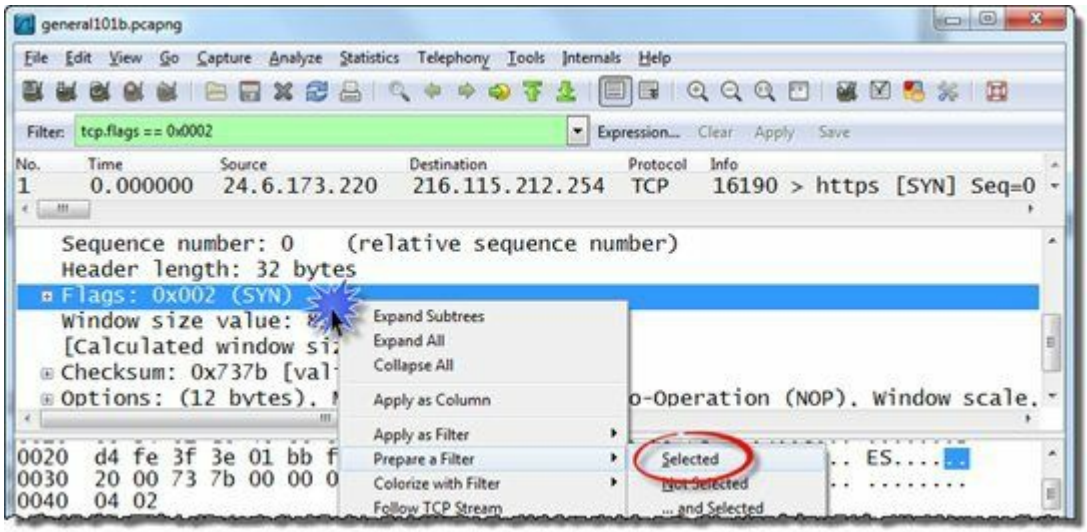
Placement of parentheses changes the meaning of these two filters.

In the first example above, port 80 traffic from 10.2.2.2 will be displayed. In addition, the first packet

of all TCP handshakes (regardless of port numbers or IP addresses) will be displayed.

In the second example above, all port 80 traffic will be displayed. In addition, the first packet of all

TCP handshakes from 10.2.2.2 will be displayed.



Lab 21: Locate TCP Connection Attempts to a Client

Client processes send TCP connection requests to server processes. There are very few reasons to

allow incoming TCP connections to user machines on your network (as they typically won't be

running server processes). In this lab we will create a display filter that detects incoming TCP

connection attempts to anyone on a particular subnet. We will focus on subnet 24.6.0.0/16.

Step 1: Open ***general101b.pcapng***.

Step 2: We first want to detect TCP connection attempts based on the TCP flags area. The first frame

in this trace file is a TCP connection request as noted by the [SYN] in the **Info** column. The response

indicates [SYN, ACK] in the **Info** column.

In the Packet List pane, expand the**TCP header** of frame 1 and right-click on the **Flags** line. Select **Prepare a Filter | Selected**. This tcp.flags==0x0002 filter will display the first packet (SYN) of

the TCP handshake.

If we had created a filter for just the TCP SYN bit set to 1 (tcp.flags.syn==1), we would see the

first two packets of each handshake (the SYN and SYN/ACK packets).

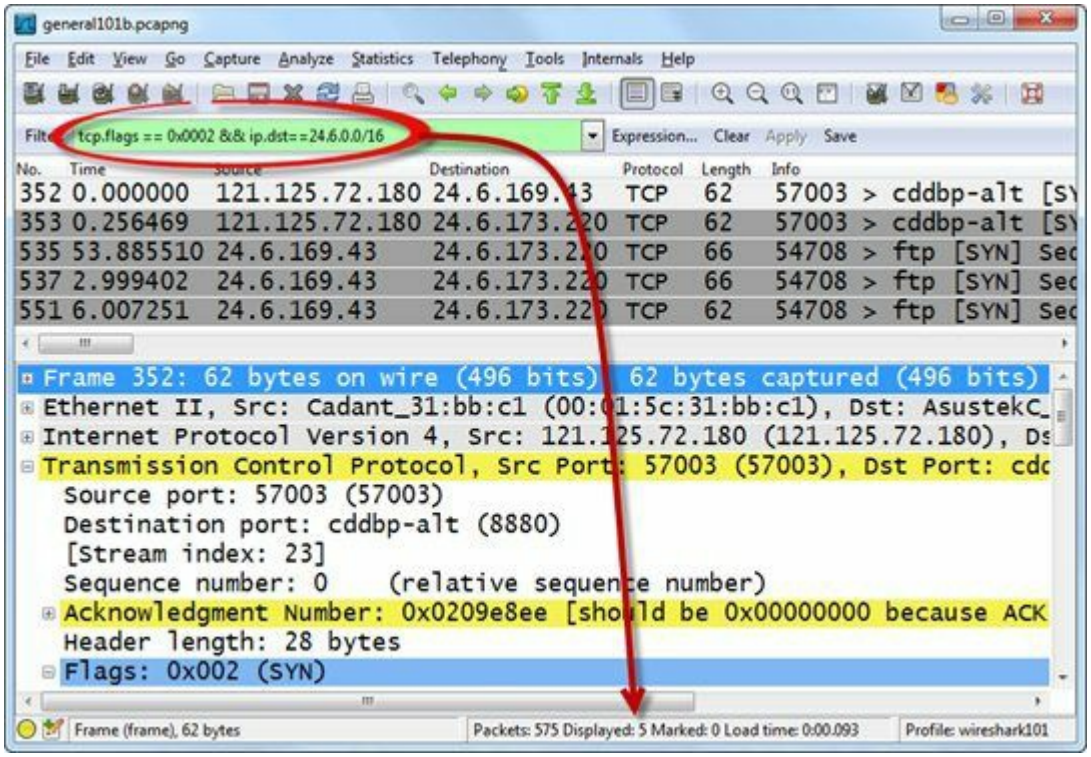
Step 3: Click **Apply** to see what this filter does. Unfortunately, this filter alone won't help us. We want to see if anyone tries to make a TCP connection to any of our clients on this network. Add &&

ip.dst==24.6.0.0/16 to your filter and click **Apply** again. Only 5 packets should match your

new filter.

Our results in this lab indicate that 121.125.72.180 and 24.6.169.43 are trying to make a connection to

24.6.173.220. Since our 24.6.173.220 client doesn't run server software, this is questionable traffic.


general101b.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
tcp.flags == 0x0002 && ip.dst==24.6.0.0/16
Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
352 0.000000 121.125.72.180 24.6.169.43 TCP 62 57003 > cddbp-alt [SY
353 0.256469 121.125.72.180 24.6.173.220 TCP 62 57003 > cddbp-alt [SY
535 53.885510 24.6.169.43 24.6.173.220 TCP 66 54708 > ftp [SYN] Seq
537 2.999402 24.6.169.43 24.6.173.220 TCP 66 54708 > ftp [SYN] Seq
551 6.007251 24.6.169.43 24.6.173.220 TCP 62 54708 > ftp [SYN] Seq
Frame 352: 62 bytes on wire (496 bits), 62 bytes captured (496 bits)
Ethernet II, Src: Cadant_31:bb:c1 (00:01:5c:31:bb:c1), Dst: AsustekC_
Internet Protocol Version 4, Src: 121.125.72.180 (121.125.72.180), Ds
Transmission Control Protocol, Src Port: 57003 (57003), Dst Port: cdd
Source port: 57003 (57003)
Destination port: cddbp-alt (8880)
[Stream index: 23]
Sequence number: 0 (relative sequence number)
Acknowledgment Number: 0x0209e8ee [should be 0x00000000 because ACK
Header length: 28 bytes
Flags: 0x002 (SYN)
Frame (frame), 62 bytes
Packets: 575 Displayed: 5 Marked: 0 Load time: 0:00.093
Profile: wireshark101

Step 4: [Lab Clean-up] Click the **Clear** button to remove your display filter before continuing.

Run this same filter on *mybackground101.pcapng* to spot another suspicious incoming connection

attempt. We found this incoming connection attempt in *Analyze Sample Background Traffic.*

3.10. Determine Why Your Display Filter

Area is Yellow

As you become more adventurous putting together display filters, you will likely hit a point when

Wireshark colors the display filter area yellow or even red. Wireshark performs error detection on

every display filter and, based on the error detection results, colors your display filter area background

red (error), green (ok), or yellow (what the heck?).

Red Background: Syntax Check Failed

When the display filter area is red, the filter will not work at all. When you click the **Apply** button,

Wireshark will generate a message such as *"ip.addr=10.2.2.2" isn't a valid display filter: "=" was unexpected in this context. See the help for a description of the display filter syntax.*

Green Background: Syntax Check Passed

When the display filter background is green, the filter will work based on the syntax checks.

Wireshark does not do a "logic check," however. Consider the filter http && udp. Normal HTTP

communications run over TCP, not UDP. No packets should match this filter. Although the filter is

illogical, it can be processed because it passes the syntax check.

Yellow Background: Syntax Check Passed with a Warning

(!=)

When the display filter background is yellow, the filter has passed the syntax check, but may not give

you the results you expect. This color is automatically triggered when Wireshark sees "!=" in a filter.

Remember to avoid this filter when you specify a field name that may match two actual fields in a

packet. For example, ip.addr indicates you are looking at both the source and destination IPv4

address fields. Another example would be tcp.port which would look at both the source and

destination port number fields.

If you use a field name that refers to a single-occurrence field, go ahead and use the "!=" syntax. For example, ip.src != 10.2.3.1 would work perfectly even though Wireshark colored the display

filter background yellow. There is only one field that could match this filter.

The two most common causes of a red background are (1) a typo in the filter and (2) using

capture filter syntax instead of display filter syntax. No matter what you try to do, a filter with a

red background will not run on Wireshark.

3.11. Filter on a Keyword in a Trace File

There will be times when you are looking for a particular word, such as "admin" in a trace file. You

may want to look through entire frames or in particular fields. You may even want to search for a text

string in upper case or lower case. All of this is possible.

Use contains in a Simple Keyword Filter through an Entire

Frame

You can use frame contains " *string*" to look for a keyword throughout a frame. For example, frame contains "admin" would look

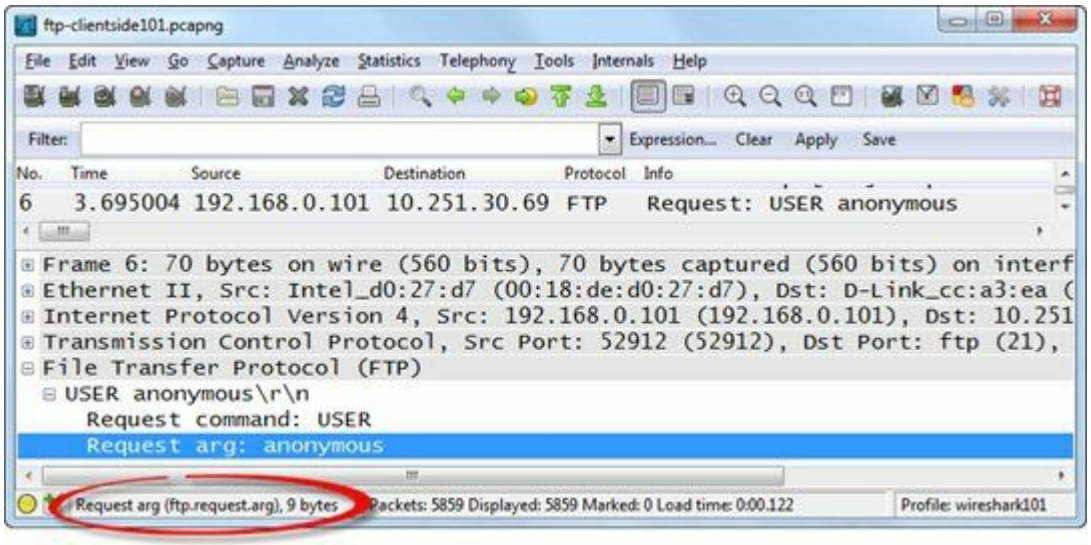
for the string *admin* (all in lower case) through the entire frame, from the Ethernet header through the Ethernet trailer.

This is really a simple and lazy filter. It might yield too many false positives. For example, if you use

this filter when you are only interested in finding out if someone tried to login to the admin FTP

account, you might also see people browsing to *www.admin.com* and file requests for

adminhandbook.pdf.


ftp-clientside101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Info
6 3.695004 192.168.0.101 10.251.30.69 FTP Request: USER anonymous
Frame 6: 70 bytes on wire (560 bits), 70 bytes captured (560 bits) on interf
Ethernet II, Src: Intel_d0:27:d7 (00:18:de:d0:27:d7), Dst: D-Link_cc:a3:ea (
Internet Protocol Version 4, Src: 192.168.0.101 (192.168.0.101), Dst: 10.251
Transmission Control Protocol, Src Port: 52912 (52912), Dst Port: ftp (21),
File Transfer Protocol (FTP)
USER anonymous\r\n
Request command: USER
Request arg: anonymous
Request arg (ftp.request.arg), 9 bytes
Packets: 5859 Displayed: 5859 Marked: 0 Load time: 0:00.122
Profile: wireshark101

Use contains in a Simple Keyword Filter based on a Field

Consider building your filter to look just at the field of interest to reduce false positives. For example,

if you look inside an FTP packet that contains a user name (packet 6 in *ftp–clientside101.pcapng*) and

expand the FTP portion fully in the Packet Details pane, you'll see the FTP user's name is in the

ftp.request.arg field as noted on the Status Bar in Figure 76. You can simply type the filter

ftp.request.arg contains "admin" to look for "admin" in the FTP request argument field.

Figure 76. Click on a field and look at the Status Bar to find out the field name to use in your filters. [ftp–clientside101.pcapng]

Use matches and (?i) in a Keyword Filter for Upper Case or

Lower Case Strings

If you are looking for Admin with an initial upper case *or* lower case letter, you can expand your last

display filter with a logical operator. The filter ftp.request.arg contains "admin" or

ftp.request.arg contains "Admin" would work.

Wireshark supports Perl-Compatible Regular Expressions (PCRE) in display filters. Regular

expressions are special text strings used to define a search pattern. If you want to filter for an entire

string in upper case or lower case, consider using Regular Expressions (regex) and the matches

operator.

For example, to look for "admin" in any variation of upper case or lower case letters in the

FTP argument field, use ftp.request.arg matches "(?i)admin". The matches operator

indicates that you are using Regular Expressions and the (?i) indicates that the search is case

insensitive.

What if you are looking anywhere in a frame for a string that contains an upper case or lower case

character at a specific location in a string? For example, consider the following strings:

buildingAeng

buildingaeng

We know "building" and "eng" are always in lower case, but the character between those strings can be either upper case or lower case.

In Wireshark, we can use frame matches "building[Aa]eng". That means we are looking

for an "A" or "a" between the lower case strings. If you are also interested in upper case or lower case B in that location, expand your display filter to frame matches "building[AaBb]eng".

Use matches for a Multiple-Word Search

There is also a simple way to combine multiple search words with regex. Combine the words in

parentheses and separate them with "|". For example, if we are interested in finding the words *cat* or *dog* in upper case or lower case anywhere in a trace file, we can use the filter frame matches "(?

i)(cat|dog)".

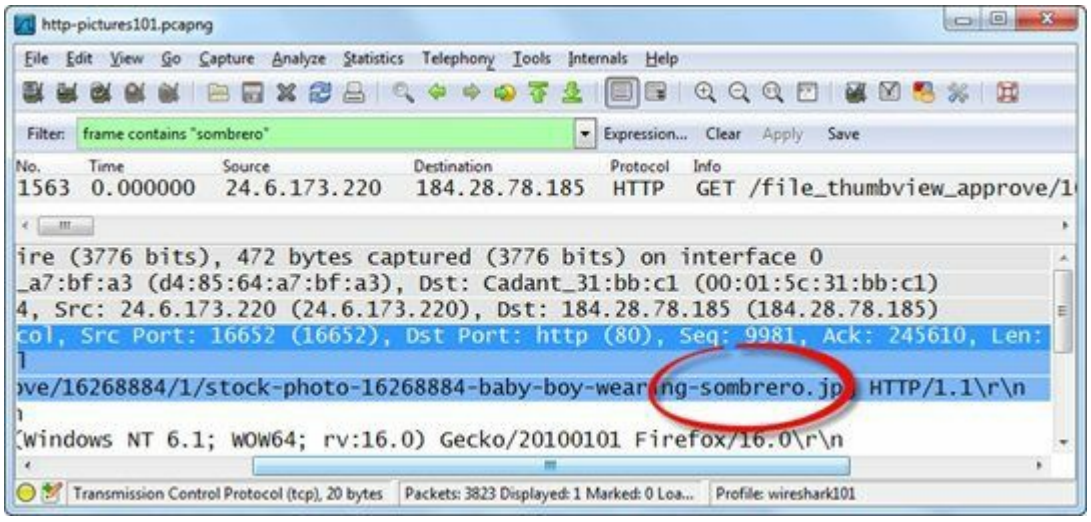
Take the time to learn regex. Visit Jan Goyvaerts' regular expressions.info web site. If you

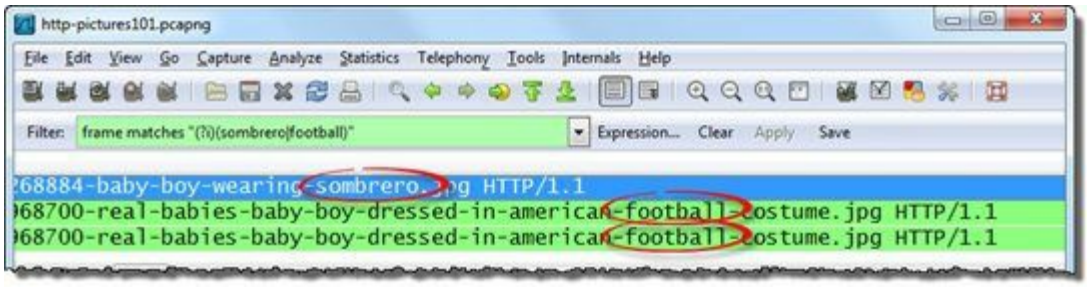
plan on adding more complex regex filters to Wireshark, consider purchasing Regex Buddy

and Regex Magic—both products were created by Jan Goyvaerts and are fabulous tools for

building, testing, and deciphering regex-based display filters. Regex is used in Wireshark as

well as Nmap and Snort.


http-pictures101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: frame contains "sombrero"
Expression... Clear Apply Save
No. Time Source Destination Protocol Info
1563 0.000000 24.6.173.220 184.28.78.185 HTTP GET /file_thumbview_approve/1
ire (3776 bits), 472 bytes captured (3776 bits) on interface 0
_a7:bf:a3 (d4:85:64:a7:bf:a3), Dst: Cadant_31:bb:c1 (00:01:5c:31:bb:c1)
4, Src: 24.6.173.220 (24.6.173.220), Dst: 184.28.78.185 (184.28.78.185)
col, Src Port: 16652 (16652), Dst Port: http (80), Seq: 9981, Ack: 245610, Len:
ve/16268884/1/stock-photo-16268884-baby-boy-wearing-sombrero.jp HTTP/1.1\r\n
(Windows NT 6.1; WOW64; rv:16.0) Gecko/20100101 Firefox/16.0\r\n
Transmission Control Protocol (tcp), 20 bytes
Packets: 3823 Displayed: 1 Marked: 0 Loa...
Profile: wireshark101



Lab 22: Filter to Locate a Set of Key Words in a Trace File

In this lab we will use the matches operator to find the keywords *sombrero* or *football* in upper case or lower case anywhere in a trace file.

Step 1: Open ***http-pictures101.pcapng***.

Step 2: Let's begin with a simple keyword filter for *sombrero*. In the display filter area, type frame contains "sombrero". One packet should match this filter.

Step 3: Now enhance your key word filter using the matches operator. Replace your previous filter

with frame matches "(?i)(sombrero|football)". Note that the monospace font makes it

appear as if there is a space between the ")" and "(", but there is no space. Three packets should match this filter.

Step 4: [Lab Clean-up] Click the **Clear** button to remove your filter before continuing.

Filtering on key words is simple using the matches operator and regular expressions. This is a useful

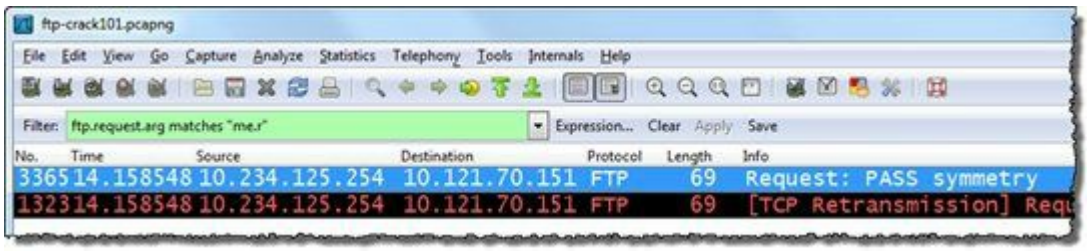
skill when looking for passwords or user account names or known-to-be-malicious patterns in your

trace files.

3.12. Use Wildcards in Your Display Filters

Sometimes you may need to look for variations in a string. In this case, you need to use a wildcard in

your display filter. This is where a solid understanding of regular expressions really comes in handy.


ftp-crack101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: ftp.request.arg matches "me.r"
Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
3365 14.158548 10.234.125.254 10.121.70.151 FTP 69 Request: PASS symmetry
132314.158548 10.234.125.254 10.121.70.151 FTP 69 [TCP Retransmission] Requ

Use Regex with "."

In Wireshark, you can use regex with the matches operator to represent a string with variables. In

regex, the "." represents any character except line break and carriage return. When you are looking for the literal ".", you must escape it with a backslash ("\").

The display filter ftp.request.arg matches "me.r" uses "." as a wildcard.

This filter will look at the string after an FTP command (ftp.request.arg) for the letters "me" followed by any character (except a line break or a carriage return) and then an "r". Try running this on *ftp-crack101.pcapng*. This filter will display two packets that contain the string *symmetry* after the PASS

command, as shown in Figure 77.

*Figure 77. Use the **matches** operator with repeating wildcards to find passwords in use. [ftp–crack101.pcapng]*

Now change the filter to allow two wildcards in between your characters. The filter

ftp.request.arg matches "me..r" will find the string *homework* in the argument field.

Setting a Variable Length Repeating Wildcard Character

Search

You can also specify that the wildcard should be repeated numerous times. The display filter would be

ftp.request.arg matches "me.{1,3}r". This filter will look for the "." (any character)

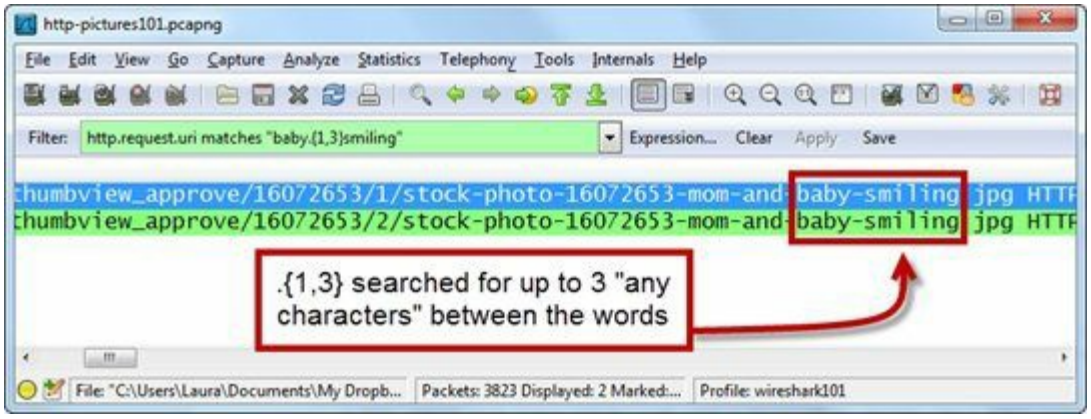
once, twice, and three times in between me and r. In *ftp-crack101.pcapng*, this filter displays packets

that contain *mercury*, *symmetry*, and *homework* in the FTP argument field. You can also add **(?i)** in front of **me** to add case insensitivity.

Once you create some great keyword filters, consider how you might combine them into a

single filter and save that one filter as a button, as explained in Turn Your Key Display Filters

into Buttons.


http-pictures101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: http.request.uri matches "baby.{1,3}smiling"
Expression... Clear Apply Save
thumbview_approve/16072653/1/stock-photo-16072653-mom-and-baby-smiling jpg HTTP
thumbview_approve/16072653/2/stock-photo-16072653-mom-and-baby-smiling jpg HTTP
.{1,3} searched for up to 3 "any characters" between the words
File: "C:\Users\Laura\Documents\My Dropb...
Packets: 3823 Displayed: 2 Marked:...
Profile: wireshark101

Lab 23: Filter with Wildcards between Words

In this lab we will use the matches operator to find the keywords *baby* and *smiling* in a trace file.

We will see how the repeating character option settings can affect what matches your filter.

Our display filter ftp.request.arg matches "me.{1,3}r" would look for the "." up to

three times between the "me" and "r" as mentioned in this section.

This time we will look for the keywords *baby* and *smiling* with up to 3 characters separating the

words.

Step 1: Open ***http-pictures101.pcapng***.

Step 2: Type the filter **http.request.uri matches "baby. {1,3}smiling"** . Two packets

should match this filter.

Step 3: Now change **{1,3}** to **{1,20}** and apply this new filter. Three packets should now match this filter because the file *stock-video-10195917-baby-on-belly-smiling.jpg* has the two words within

20 characters.

Step 4: [Lab Clean-up] Click the **Clear** button to remove your display filter before continuing.

This is another great type of filter to master. Many times, when looking for security breaches, we try

to locate strings within a certain distance from each other.

3.13. Use Filters to Spot Communication

Delays

When someone complains of slow network performance, look for delays between packets as a sign

that a network path, client, or server is slow. Create a filter to look for these delays to spot these

problems faster.

There are two time measurements that can be used to filter on delays in a trace file—basic delta time

and TCP delta time.

Filter on Large Delta Times (frame.time_delta)

The frame.time_delta field is located in the Frame section of each packet. You can create a

filter for large values in this field. To set a filter for delays over 1 second, use frame.time_delta

> 1. Keep in mind, however, that this filter looks at all the packets in the trace file to display the time

from the end of one packet to the end of the next packet. Conversations can be intermingled, however,

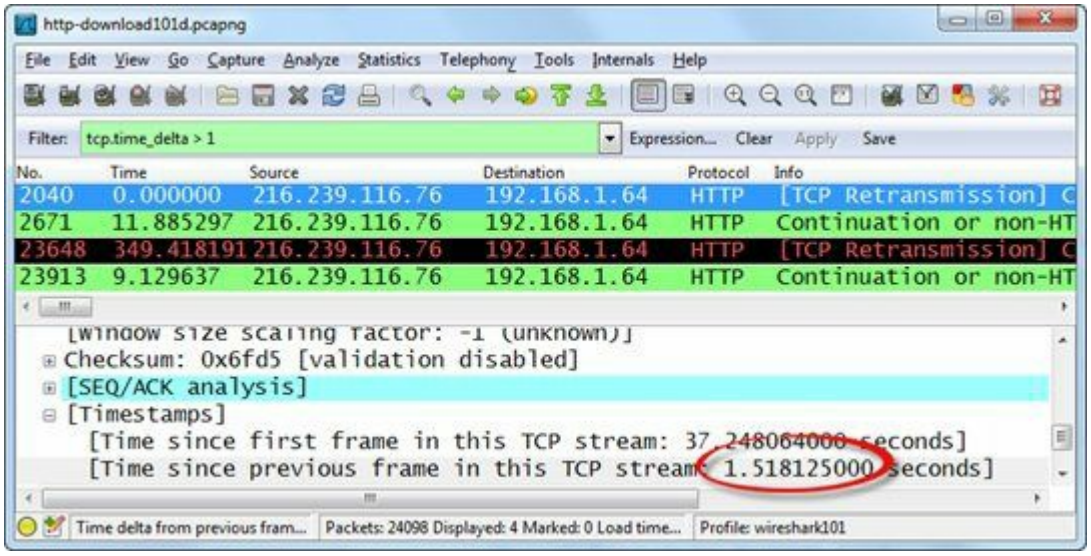
and delays in a UDP or TCP conversation can go unnoticed because of intervening packets from other

conversations.

If you are troubleshooting a UDP-based application, filter on UDP (udp) and then use **File | Export**

Specified Packets and save a new trace file. Apply your frame.time_delta filter to the new

trace file.


http-download101d.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: tcp.time_delta > 1
Expression... Clear Apply Save
No. Time Source Destination Protocol Info
2040 0.000000 216.239.116.76 192.168.1.64 HTTP [TCP Retransmission] C
2671 11.885297 216.239.116.76 192.168.1.64 HTTP Continuation or non-HT
23648 349.418191 216.239.116.76 192.168.1.64 HTTP [TCP Retransmission] C
23913 9.129637 216.239.116.76 192.168.1.64 HTTP Continuation or non-HT
[Window size scaling factor: -1 (unknown)]
Checksum: 0x6fd5 [validation disabled]
[SEQ/ACK analysis]
[Timestamps]
[Time since first frame in this TCP stream: 37.248064000 seconds]
[Time since previous frame in this TCP stream: 1.518125000 seconds]
Time delta from previous fram...
Packets: 24098 Displayed: 4 Marked: 0 Load time...
Profile: wireshark101

Filter on Large TCP Delta Times (tcp.time_delta)

The tcp.time_delta value can only be used after you enable Wireshark's *Calculate conversation*

timestamps TCP preference.

In Lab 6, you enabled the TCP timestamps by selecting **Edit | Preferences | (+) Protocols | TCP** and

checking the *Calculate conversation timestamps* setting. Once this setting is enabled, a [Timestamp]

section is added to the end of each expanded TCP header in the Packet Details pane, as shown in

Figure 78.

We applied a filter for TCP delta delays over 1 second with tcp.time_delta > 1. There are four packets

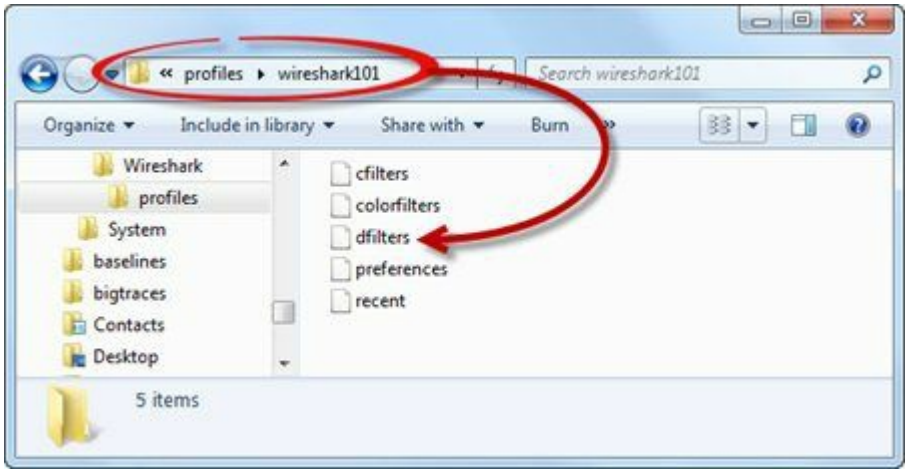
that arrived over 1 second after the previous packet in their TCP stream.

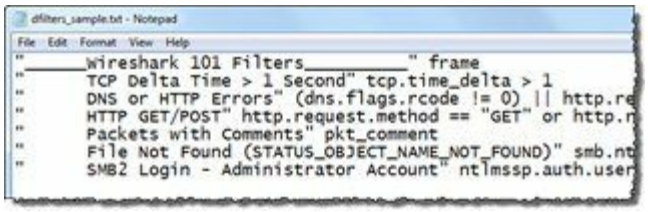
Consider clicking **Save** to make this a Filter Expression button. See *Turn Your Key Display Filters*

[into Buttons.]

Figure 78. The new [Timestamps] section appears after you enable ***Calculate conversation timestamps*** *in your TCP*

preferences. Now you can filter on the TCP delta value. [http-download101d.pcapng]




dfilters_sample.txt - Notepad
File Edit Format View Help
"_____Wireshark 101 Filters_____" frame
"TCP Delta Time > 1 Second" tcp.time_delta > 1
"DNS or HTTP Errors" (dns.flags.rcode != 0) || http.re
"HTTP GET/POST" http.request.method == "GET" or http.r
"Packets with Comments" pkt_comment
"File Not Found (STATUS_OBJECT_NAME_NOT_FOUND)" smb.nt
"SMB2 Login - Administrator Account" ntlmssp.auth.user

Lab 24: Import Display Filters into a Profile

In this lab you will download a set of display filters from [www.wiresharkbook.com] and import them into your existing display filter file (*dfilters*). Use this same technique if you want to move display

filters from one profile to another on a single host or other Wireshark systems.

Step 1: Look in the **Status Bar** to determine your current profile. You should be using the

wireshark101 profile created in Lab 7.

Step 2: Open your personal configuration folder using **Help | About Wireshark | Folder | Personal**

configuration and double-clicking on the folder hyperlink.

Negotiate to the ***profiles*** directory and locate the *wireshark101* directory, as shown below.

Step 3: You created a **My IP Address** filter in Lab 16, therefore you should already have a *dfilters* file. If you don't have that file, return to Lab 16.

Open the ***dfilters*** file with a text editor.

Step 4: Now download the ***dfilters_sample.txt*** file from *www.wiresharkbook.com.* This file contains 6

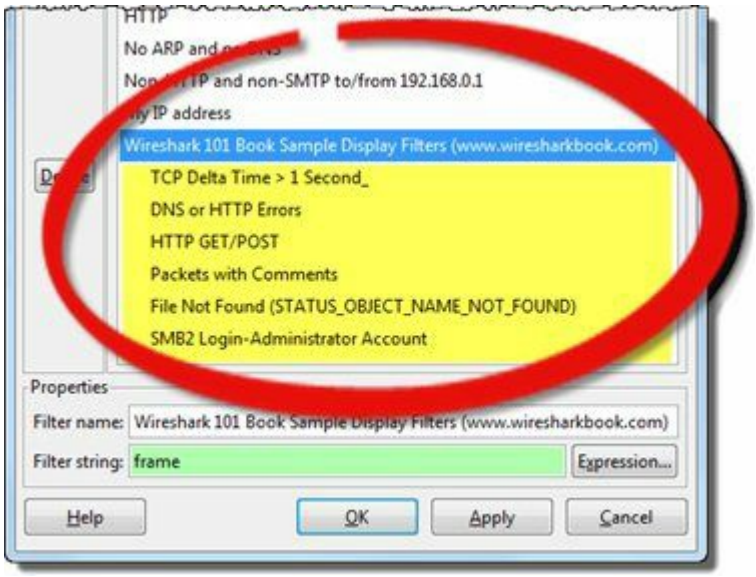
display filters (and one heading line) that we will add to your existing *dfilters* file.

Step 5: Open ***dfilters_sample.txt*** and copy the contents to your buffer.

Step 6: Toggle to the ***dfilters*** file in your *Wireshark101* directory and paste the contents onto the end of the display filters listed. **Make sure you add a blank line at the end of the *dfilters* file or your last filter will not be displayed.** Close and save your edited *dfilters* file.

Step 7: Return to Wireshark. The *dfilters* file is loaded when you load your profile. Change to the *Default* profile and return to the

wireshark101 profile.



Step 8: Click on the **Filter** button on the filter toolbar. You should see your new display filters at the bottom of the list[37].

It is easy to share filters because filters are simple text files (*cfilters* for capture filters and *dfilters* for display filters). If you are working on a team, consider creating a master set of filters that are created

and shared by the team.

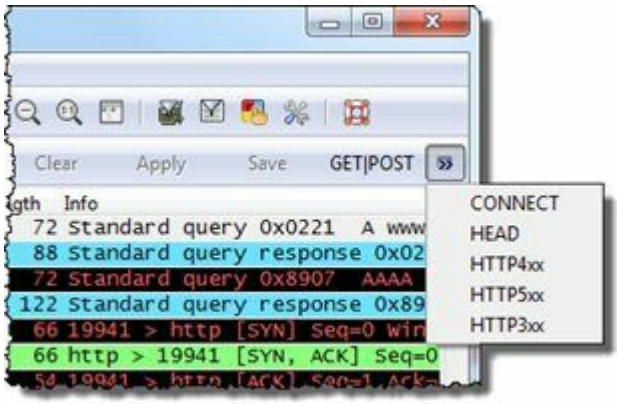
3.14. Turn Your Key Display Filters into

Buttons

You want your analysis processes to be as efficient as possible. In order to do this, make your most

popular display filters into buttons in the display filter area. This way you can quickly open a trace file

and click a button to filter on key packet characteristics.



Create a Filter Expression Button

It is very easy to turn a display filter into a button. Simply type your display filter in the display filter

area and click the **Save** button. Name your filter as shown in Figure 79 and click the **OK** button.

*Figure 79. Click the **Save** button and name your Filter Expression button.*

There are no limits to the number of Filter Expression buttons you can create. If you run out of room

for your buttons, Wireshark displays ">>", which you can click on to see more buttons.

In Figure 80, we created six Filter Expression buttons to use when analyzing HTTP traffic. Not all of

the Filter Expression buttons can fit in the display filter area because we reduced the size of our

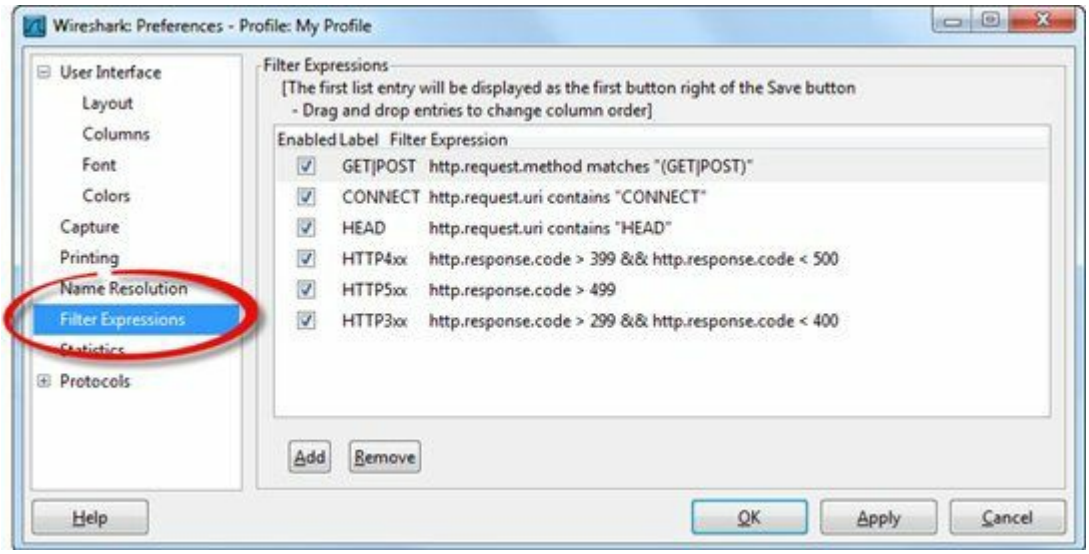
Wireshark window. Wireshark places one Filter Expression button (GET|POST) in the display filter

area, but we must click **>>** to view and select one of the remaining five Filter Expression buttons.

If we keep adding to the Filter Expression buttons list, eventually, Wireshark will place a down arrow

at the bottom of the list so we can scroll further in the list.

*Figure 80. Click **>>** to view Filter Expression buttons that won't fit in the display filter area.*



Edit, Reorder, Delete, and Disable Filter Expression Buttons

There is a **Save** button in the display filter area, but there is no **Edit** button and no right–click

capability on your new Filter Expression button. To edit, reorder, delete, or disable your Filter

Expression buttons select **Edit | Preferences | Filter Expressions**, as shown in Figure 81.

*Figure 81. You must access Wireshark's Preferences window to edit, reorder, delete, or disable **Filter Expression** buttons.*

Edit the Filter Expression Area in Your *preferences* File

Filter Expression buttons are saved in the *preferences* file of the profile in which you are currently

working. Your current profile is shown in the right-hand column of the Status Bar. To find your

profile's *preferences* file, select **Help | About Wireshark | Folders** and double-click the **Personal Configurations** folder hyperlink. The *preferences* file for the *Default* profile is in this directory. The *preferences* files for any other profiles are in a directory under the *profiles* directory.

The *preferences* file is just a text file. Don't be afraid to edit the file directly with a text editor. Filter Expression button settings are maintained under the Filter Expressions heading.

The following is a sample of the Filter Expression area in the *preferences* file. These settings are used to create the Filter Expression buttons seen in Figure 81.

####### Filter Expressions #########

gui.filter_expressions.label: GET|POST

gui.filter_expressions.enabled: TRUE

gui.filter_expressions.expr: http.request.method matches "(GET|POST)"

gui.filter_expressions.label: CONNECT

gui.filter_expressions.enabled: TRUE

gui.filter_expressions.expr: http.request.uri contains "CONNECT"

gui.filter_expressions.label: HEAD

gui.filter_expressions.enabled: TRUE

gui.filter_expressions.expr: http.request.uri contains "HEAD"

gui.filter_expressions.label: HTTP4xx

gui.filter_expressions.enabled: TRUE

gui.filter_expressions.expr: http.response.code > 399 &&

http.response.code < 500

gui.filter_expressions.label: HTTP5xx

gui.filter_expressions.enabled: TRUE

gui.filter_expressions.expr: http.response.code > 499

gui.filter_expressions.label: HTTP3xx

gui.filter_expressions.enabled: TRUE

gui.filter_expressions.expr: http.response.code > 299 &&

http.response.code < 400

These buttons are also just lines in a text file. When you create some wonderful Filter

Expression buttons, share them with your team.

http-chappellu101b.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
GET|POST
No. Time Source Destination Protocol Info

An integer value greater than 0.
#taps.rtp_player_max_visible: 4
####### Filter Expressions ########
gui.filter_expressions.label: GET|POST
gui.filter_expressions.enabled: TRUE
gui.filter_expressions.expr: http.request.method matches "(GET|POST)"
####### Protocols ########
Display hidden items in packet details pane?
TRUE or FALSE (case-insensitive).

Lab 25: Create and Import HTTP Filter Expression Buttons

We will begin by creating a single Filter Expression button and then we'll import a set of Filter

Expression buttons. At the time this book was written, there wasn't an easy way to turn all your

display filters into Filter Expression buttons. That would be a great feature and maybe we'll see that

someday and we can replace this lab with another lab about conquering world hunger with customized

profiles. Until then, follow along with this lab to import the Filter Expression buttons show in Figure

81 into your *wireshark101* profile.

Step 1: Open ***http-chappellu101b.pcapng***.

Step 2: Type **http.request.method matches "(GET|POST)"** in the filter area. Click **Save**.

Enter **GET|POST** to name your Filter Expression button and click **OK**.

The new GET|POST Filter Expression button is displayed on the display filter toolbar.

Step 3: Click the **GET|POST** button to view the 45 packets that match this filter. This is a great

button to quickly view requests or information sent to a web server.

This is the standard process used to add a single Filter Expression button. Next we will import a set of

Filter Expression buttons directly into the *preferences* file for your *Wireshark101* profile.

Step 4: Use a text editor, such as WordPad, to open your ***preferences*** file (contained in your *wireshark101* profile directory).

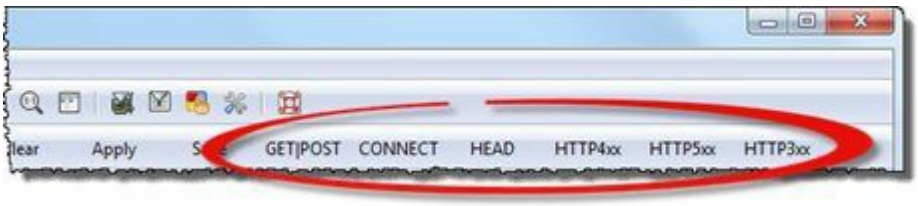
(If you can't remember how to get to this directory, select **Help | About Wireshark | Folders** and

double-click on the hyperlink to your **personal configuration folder**. Look inside the *profiles* folder for your *wireshark101* folder.)

Step 5: Use the Find feature of your text editor to locate the **Filter Expressions** area in your

preferences file. You will see that you already have a GET|POST Filter Expression button entry as

shown in the image below.



Step 6: Download the ***filterexpressions101.txt*** file from www.wiresharkbook.com and open this file in your text editor. Copy the contents of this file directly under your new GET|POST entry in the

####### Filter Expressions ######## area. Save and close your *preferences* file.

Step 7: You must reload your ***wireshark101*** profile to see your new Filter Expression buttons. Simply click on the **Profile** area of the Status Bar, select another profile, and then perform the same steps to

return to your ***wireshark101*** profile.

Step 8: [Lab Clean-up] If you do not want these new Filter Expressions buttons to remain visible,

click the **Edit Preferences** button on the main toolbar and select **Filter Expressions**. Uncheck the

Filter Expressions listed and click **OK**.

Remember that if you have too many buttons to fit in your display filter area, Wireshark displays >>.

Click on the double arrows to expand your Filter Expression button list.

Chapter 3 Challenge

Open *challenge101-3.pcapng* and use your display filter and coloring rule skills to locate traffic based

on addresses, protocols and keywords to answer these Challenge questions. The answer key is located

in Appendix A.

You will practice your display filter to locate traffic based on addresses, protocols, and keywords.

Question 3-1.

How many frames travel to or from 80.78.246.209?

Question 3-2.

How many DNS packets are in this trace file?

Question 3-3.

How many frames have the TCP SYN bit set to 1?

Question 3-4.

How many frames contain the string "set-cookie" in upper case or lower case?

Question 3-5.

How many frames contain a TCP delta time greater than 1 second?

Chapter 4 Skills: Color and Export

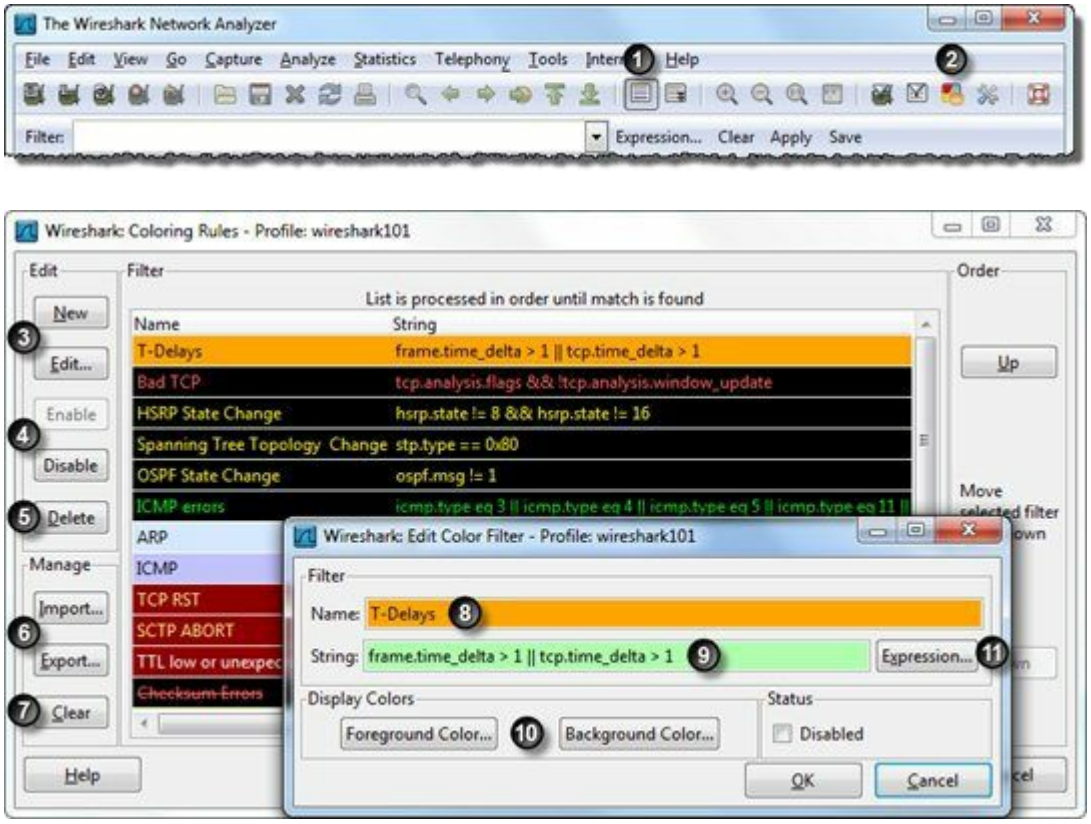
Interesting Packets

"Wireshark is one of those tools that every engineer is a bit afraid to use. It's like bringing the big guns on board. Once you get familiar with it and tame the beast, this is the most powerful tool you will

have on your networking tool belt."

Lionel Gentil

iTunes Software Reliability Engineer, Apple, Inc.



Quick Reference: Coloring Rules Interface

1. Enable/disable all coloring rules

2. Launch the Coloring Rules window

3. Create or edit coloring rules (double-click on a coloring rule to open)

4. Enable/disable the selected coloring rule (line strikeout appears over rule)

5. Delete the selected coloring rule (select **Clear** to reload default coloring rules)

6. Import/export coloring rules (imported file name will be changed to *colorfilters*)

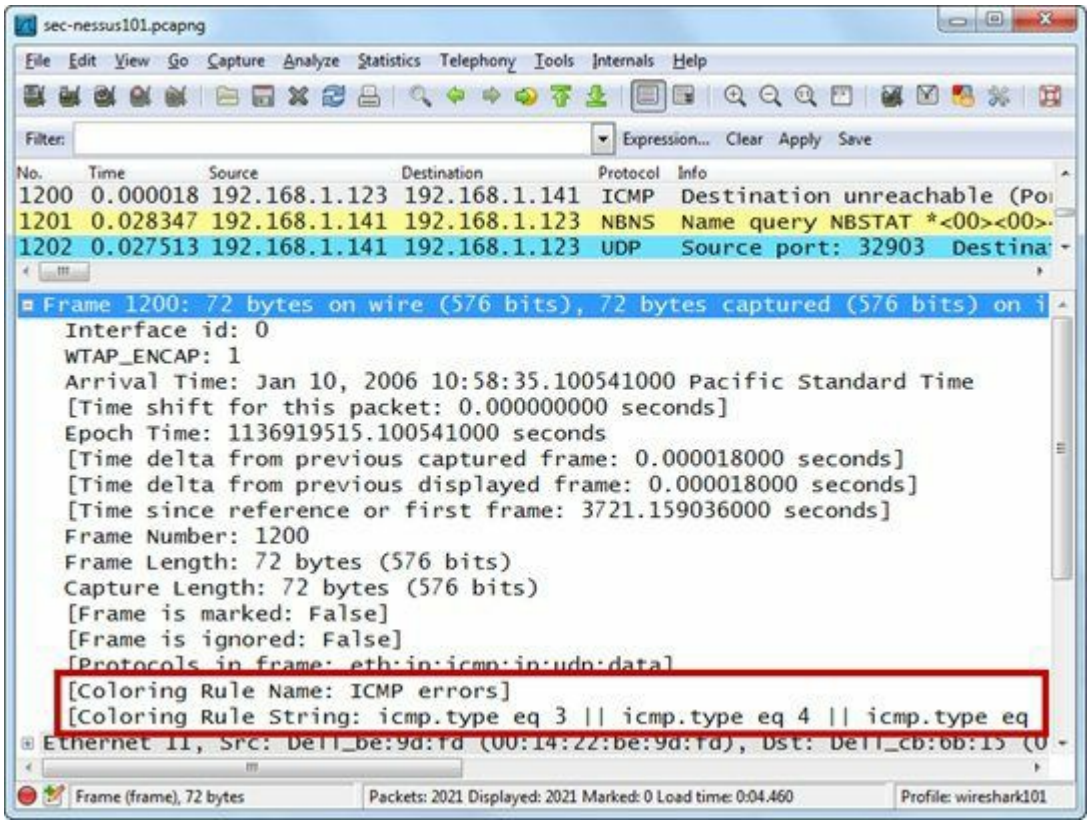
7. Return to original coloring rules set

8. Coloring rule name (shows current foreground/background color scheme)

9. Coloring rule string (based on display filter syntax)

10. Set foreground (text) and background color (uses Pango color set)

11. Use Expressions to create the coloring rule string


sec-nessus101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Info
1200 0.000018 192.168.1.123 192.168.1.141 ICMP Destination unreachable (Po
1201 0.028347 192.168.1.141 192.168.1.123 NBNS Name query NBSTAT *<00><00>
1202 0.027513 192.168.1.141 192.168.1.123 UDP Source port: 32903 Destina
Frame 1200: 72 bytes on wire (576 bits), 72 bytes captured (576 bits) on i
Interface id: 0
WTAP_ENCAP: 1
Arrival Time: Jan 10, 2006 10:58:35.100541000 Pacific Standard Time
[Time shift for this packet: 0.000000000 seconds]
Epoch Time: 1136919515.100541000 seconds
[Time delta from previous captured frame: 0.000018000 seconds]
[Time delta from previous displayed frame: 0.000018000 seconds]
[Time since reference or first frame: 3721.159036000 seconds]
Frame Number: 1200
Frame Length: 72 bytes (576 bits)
Capture Length: 72 bytes (576 bits)
[Frame is marked: False]
[Frame is ignored: False]
[Protocols in frame: eth:ip:icmp:ip:udp:data]
[Coloring Rule Name: ICMP errors]
[Coloring Rule String: icmp.type eq 3 || icmp.type eq 4 || icmp.type eq
Ethernet II, Src: Dell_be:9d:fd (00:14:22:be:9d:fd), Dst: Dell_cb:6b:15 (0
Frame (frame), 72 bytes
Packets: 2021 Displayed: 2021 Marked: 0 Load time: 0:04.460
Profile: wireshark101

TIP

4.1. Identify Applied Coloring Rules

Wireshark automatically colors packets based on a default set of coloring rules. If you become

familiar with this default set of colors, you can quickly identify packet types based on their colors

instead of spending time digging into the packets.

To quickly determine why a packet is colored a certain way, expand the Frame section of the packet

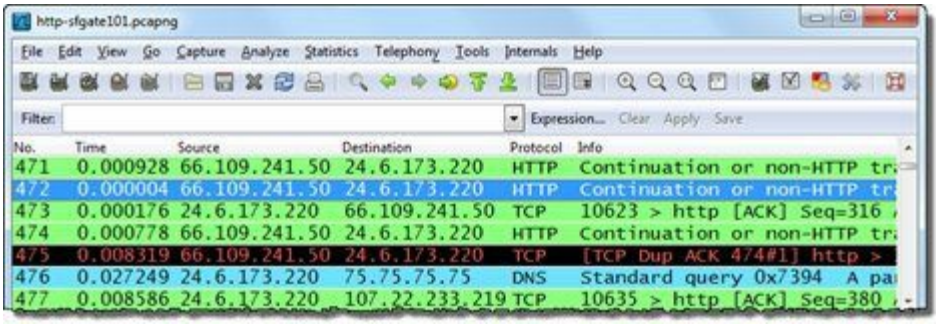
and look at the Coloring Rule Name and Coloring Rule String lines, as shown in Figure 82.

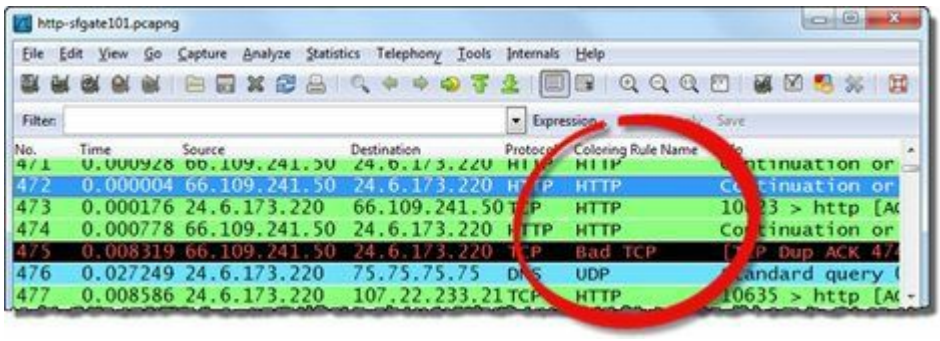
Figure 82. Look inside the Frame section of a packet to find out why a packet is colored a certain way. [sec–nessus101.pcapng]

Coloring rules are maintained in a text file called colorfilters. This file can be edited with a text

editor, but since it is loaded when you open a profile, you must switch to another profile and

return to the current profile to see the changes.


http-sfgate101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Info
471 0.000928 66.109.241.50 24.6.173.220 HTTP Continuation or non-HTTP tr
472 0.000004 66.109.241.50 24.6.173.220 HTTP Continuation or non-HTTP tr
473 0.000176 24.6.173.220 66.109.241.50 TCP 10623 > http [ACK] Seq=316
474 0.000778 66.109.241.50 24.6.173.220 HTTP Continuation or non-HTTP tr
475 0.008319 66.109.241.50 24.6.173.220 TCP [TCP Dup ACK 474#1] http >
476 0.027249 24.6.173.220 75.75.75.75 DNS Standard query 0x7394 A pa
477 0.008586 24.6.173.220 107.22.233.219 TCP 10635 > http [ACK] Seq=380


http-sfgate101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression...
Save
No. Time Source Destination Protocol Coloring Rule Name Info
472 0.000004 66.109.241.50 24.6.173.220 HTTP HTTP
473 0.000176 24.6.173.220 66.109.241.50 HTTP HTTP
474 0.000778 66.109.241.50 24.6.173.220 HTTP HTTP
475 0.008319 66.109.241.50 24.6.173.220 Bad TCP
476 0.027249 24.6.173.220 75.75.75.75 UDP
477 0.008586 24.6.173.220 107.22.233.21 HTTP

Lab 26: Add a Column to Display Coloring Rules in Use

Adding a column to identify coloring rules is a great idea when you are new to Wireshark or you just

aren't familiar with the coloring rules set.

***Note**: As of Wireshark 1.9.0 (which is the development version leading to Wireshark 1.10), this custom color column can be buggy and suddenly not display the information properly. Hopefully this issue*

will be solved in a later version of Wireshark.

Step 1: Open ***http-sfgate101.pcapng***.

Step 2: Click the **Go To** button

on the main toolbar to go to **frame 472**.

We see three different coloring rules applied to this area of the trace file. The darker blue highlight

line for the selected packet is not colored based on any coloring rule. If frame 473 has a black

background on your system, return to Lab 6 and follow the instructions to disable your IP, UDP, and

TCP checksum validation settings. To completely disable that coloring rule, see the instructions

contained in *Disable Individual Coloring Rules* .

Step 3: Expand the Frame section in the Packet Details pane for **frame 472**. Frame 472 matches the

HTTP coloring rule which uses a green background and black foreground (text).

Step 4: Right-click on the **Coloring Rule Name** field in the Frame section and select **Apply as**

Column. Use this column when you want to quickly list the coloring rule applied to each frame.

Step 5: [Lab Clean-up] Right-click on the **Coloring Rule Name** column heading and select **Hide**

Column. When you want to see this column again, right-click on any column heading and select

Displayed Column | Coloring Rule Name.

We can see that we have packets that matched the HTTP, Bad TCP, and UDP coloring rules at this

point in the trace file. Learning the default set of coloring rules helps you quickly understand

communications behaviors.

4.2. Turn Off the Checksum Error Coloring

Rule

If you have TCP, UDP, and IP checksum validation preference settings enabled and you are capturing

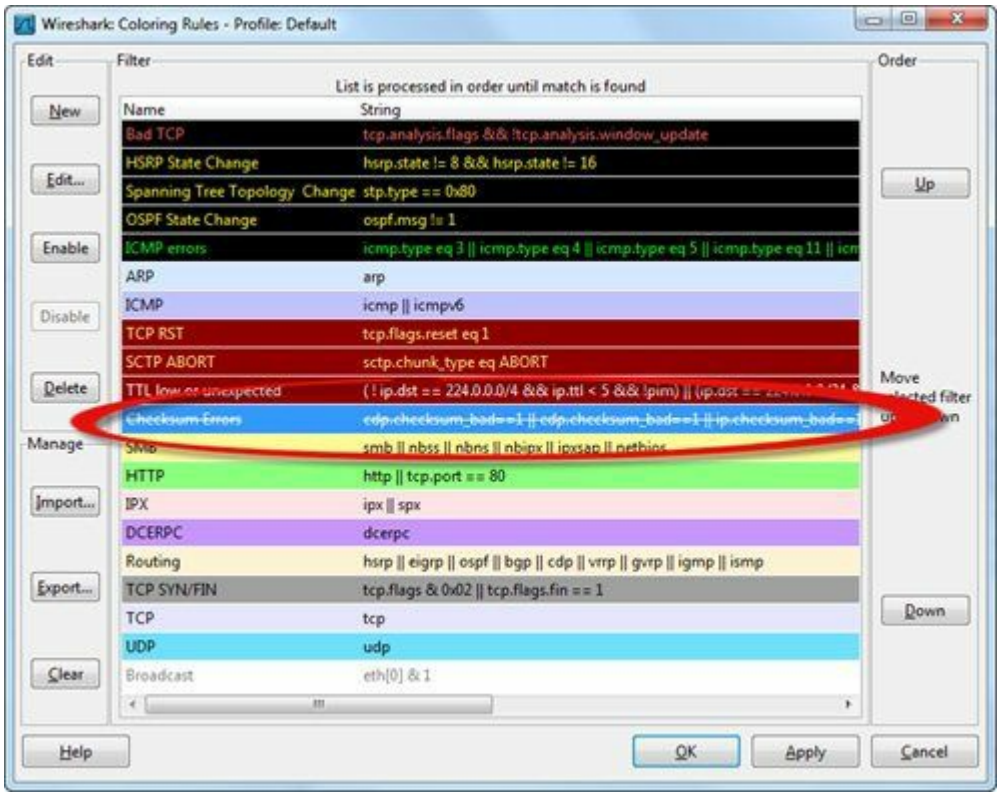
on a host that uses task offload, the Checksum Error coloring rule will create false positive coloring

on your trace file. When a system supports task offloading, valid checksums are applied by the

network interface card before the frame is sent on the network. Wireshark captures a copy of the

packets before that valid checksum is appended to the frames. Consider disabling the Checksum

Errors coloring rule or disabling checksum validation (as we did in Lab 6).



Disable Individual Coloring Rules

To disable one or more coloring rules, open the Coloring Rules window by clicking the **Coloring**

Rules button on the main toolbar. Click on a coloring rule and then click the **Disable** button. The

coloring rule is displayed with a line through it, as shown in Figure 83.

*Figure 83. Select the **Checksum Errors** coloring rule and click the **Disable** button to remove false positives caused by task offloading.*

Disable All Packet Coloring

If you just can't stand working with the coloring rules on, you can toggle all coloring on or off using

View | Colorize Packet List or click the **Colorize Packet List** button on the main toolbar.

One of the most irritating coloring rules is the Checksum Errors coloring rule. Prior to

Wireshark version 1.8.x, IP, UDP, and TCP checksum validations were enabled in the

respective protocols' preference settings. Since lots of machines use task offloading (with

checksum calculations offloaded to the network card), it was common to find all outbound

packets from these systems colored with the "Bad Checksum" coloring rule although the

adapter applied a perfectly good checksum to the frame before sending it onto the network.

If you updated Wireshark, you may have retrained earlier checksum validation settings and

you might still see Bad Checksum coloring in your trace file. To remove these inaccurate

indications, the best option is to turn off the checksum validation setting for IP, UDP, and TCP

*using **Edit | Preferences | (+) Protocols** and disabling the setting for IP, UDP, and TCP.*

Otherwise, you can simply disable the Checksum Errors coloring rule, as shown in Figure 83.

If you just disable the coloring rule, Wireshark may still indicate that you have checksum

errors inside the frame, but the Bad Checksum coloring rule will not be applied to the packets

in the Packet List pane.

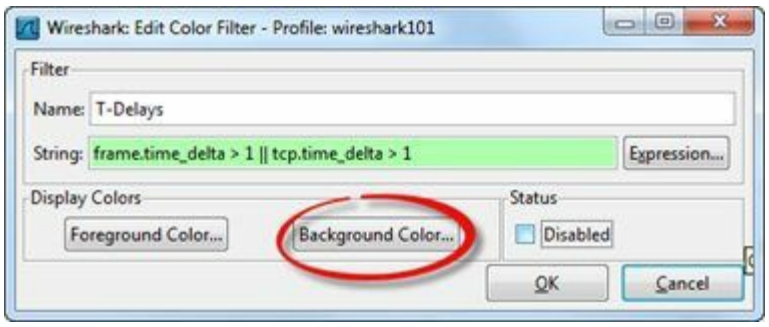
4.3. Build a Coloring Rule to Highlight

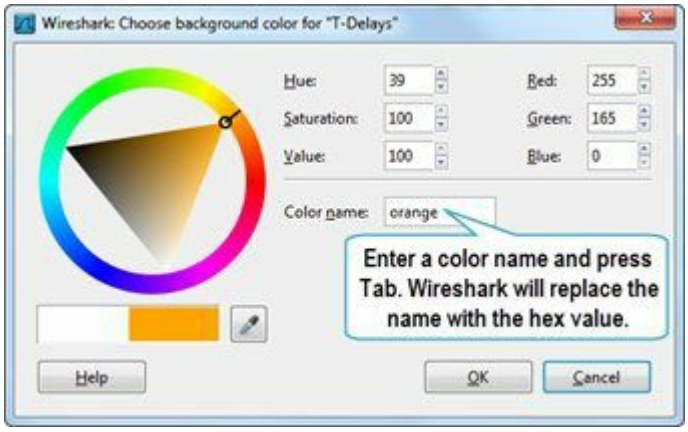
Delays

When users complain about slow network performance, look for delays between packets in their

communications. You can easily create a coloring rule to call your attention to these delays in UDP-

based or TCP-based communications.





Create a Coloring Rule from Scratch

In *Use Filters to Spot Communication Delays*, you learned how to filter on delays in a trace file. You can use a similar technique to create a single coloring rule to detect packets that have a high delta

time.

Since coloring rule strings use display filter syntax, you can easily turn any of your display filters into

coloring rules by copying the display filter into the coloring rule string area.

Select **View | Coloring Rules | New** and enter the name **T-Delays**. In the String area, type

frame.time_delta > 1 || tcp.time_delta > 1, as shown in Figure 84.

Figure 84. Enter the coloring rule name and string and then set the background color.

Now it's time to set the foreground (text) and background color for your coloring rule.

The color names used by Wireshark's color picker come from the Pango library. The list of available

color names can be found at *git.gnome.org/browse/pango/tree/pango/pango-color-table.h.* That file is generated from the "rgb.txt" file that ships with standard X11 distributions[38]. A short version of the color names list, along with color samples, can be found at *en.wikipedia.org/wiki/X11_color_names.*

Note that many of the colors have the numbers 1 through 4 affixed to the end of the name to offer a

darker shade of the color.

Click the **Background Color** button, type **orange** in the Color name area, as shown in Figure 85, and

then press **Enter**. Wireshark will automatically change the word "orange" to its hex value, #FFA500.

Click **OK**.

Figure 85. Wireshark recognizes hundreds of color names, which is the easiest way to assign colors.

Wireshark always shows the foreground and background coloring scheme in the Name field so you

can ensure it looks just the way you want, as shown in Figure 86 (color is visible in the eBook

version).

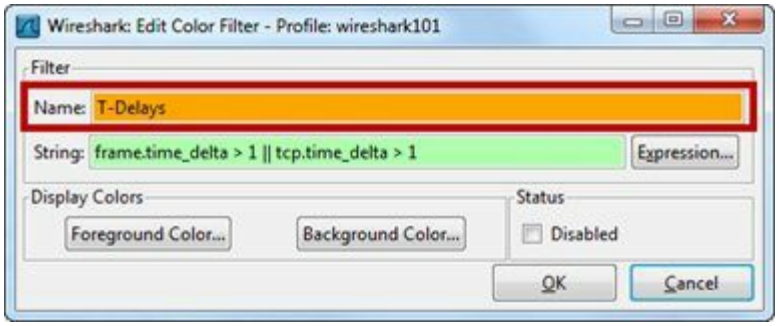
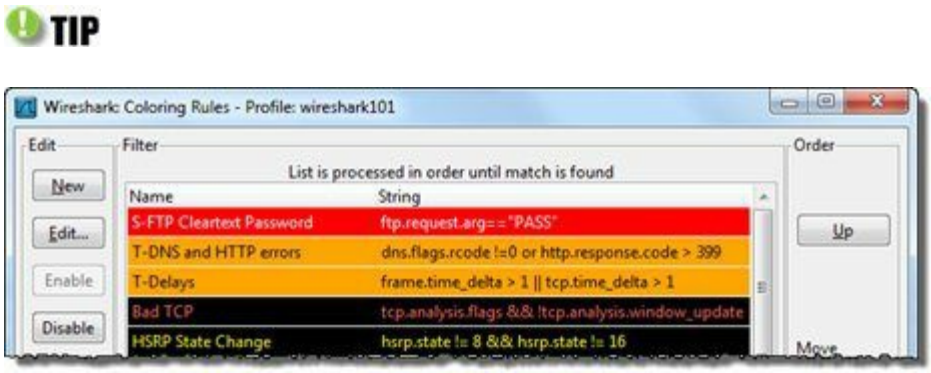


Figure 86. Wireshark applies your foreground and background color scheme to the Name field.

Your new coloring rule will automatically be placed at the top of the Coloring Rules set. Placement of

coloring rules is important as packets are processed in order from top to bottom through the coloring

rules list. Put your most important coloring rules at the top of the list.



Use the Right-Click Method to Create a Coloring Rule

The fastest way to create a new coloring rule is to select the field of interest in the Packet Details

pane, right-click and select **Colorize with Filter | New Coloring Rule**.

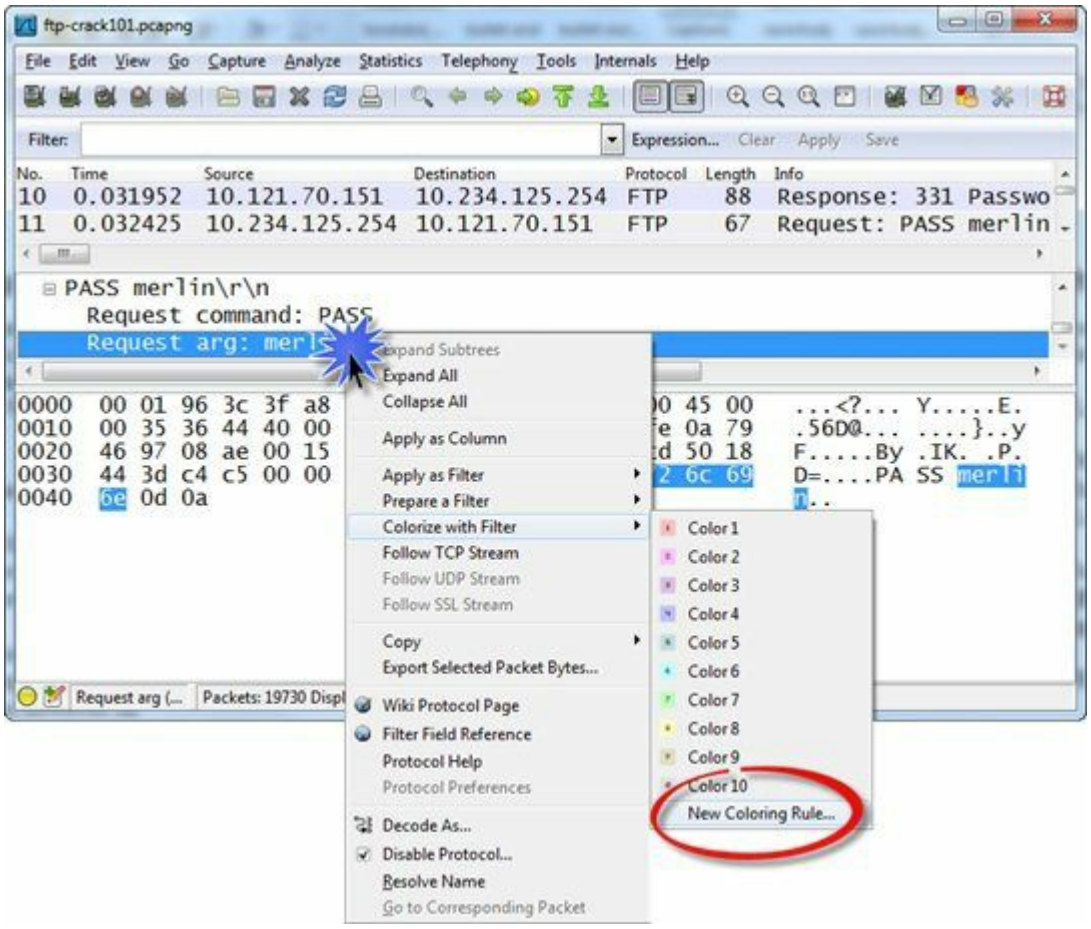
Plan your coloring and naming scheme in advance. For example, if a color highlights a

performance problem, affix "T-" (for "troubleshooting") to the front of the coloring rule name and make all your troubleshooting coloring rule backgrounds orange. Affix "S-" (for "security") to the front of security coloring rules and set the background color of these rules to red. This

will help you quickly classify the traffic just based on the color displayed.

The example shown below includes one security coloring rule prefaced with "S-" and two

troubleshooting coloring rules prefaced by "T-".



Lab 27: Build a Coloring Rule to Highlight FTP User Names,

Passwords, and More

In this lab you will create a coloring rule to call your attention to FTP request arguments, including

those associated with USER, PASS, TYPE, SIZE, MDTM, RETR, and CWD commands. We will use

ftp-crack101.pcapng again.

Step 1: Open ***ftp-crack101.pcapng***. We began capturing in the middle of various FTP

communications. In frame 11 we can see "Request: PASS merlin" in the **Info** column of the Packet

List pane.

Step 2: In the Packet Details pane of frame 11, fully expand the **File Transfer Protocol (FTP)** line.

There are two sections: Request command and Request arg(ument).

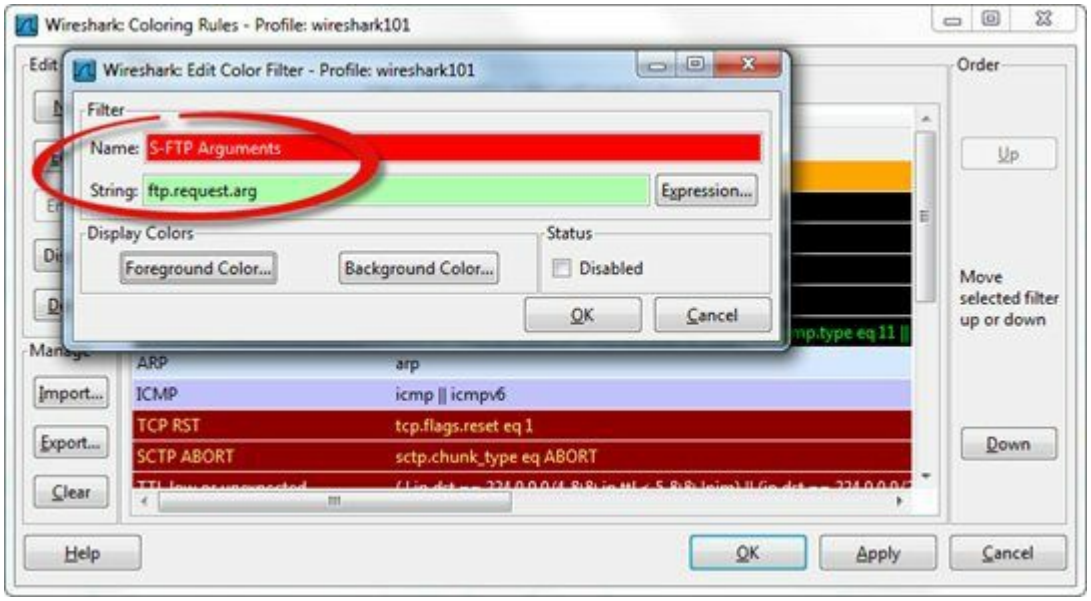
Step 3: Right-click on the **Request arg** line and select **Colorize with Filter | New Coloring Rule**, as shown below.

Step 4: In the Edit Color Filter window, name your coloring rule " **S-FTP Arguments.** [39]" Edit the String to just ftp.request.arg.

Click the **Background Color** button and enter **red** in the Color name area. Click **OK** to save your background color setting. Click the **Foreground Color** button and enter **white** in the Color name area.

Click **OK** to save your foreground color setting.

Click **OK** to close the Edit Color Filter window and **OK** to close the Coloring Rules window.



Step 5: Scroll through this trace file to identify the other frames that match your new coloring rule.

You should easily be able to spot FTP user names and passwords that were captured in this trace file.

Use the right-click method to quickly make coloring rules. At times you may just right-click and

accept the filter string "as is"—other times you might decide to edit the string to be less or more

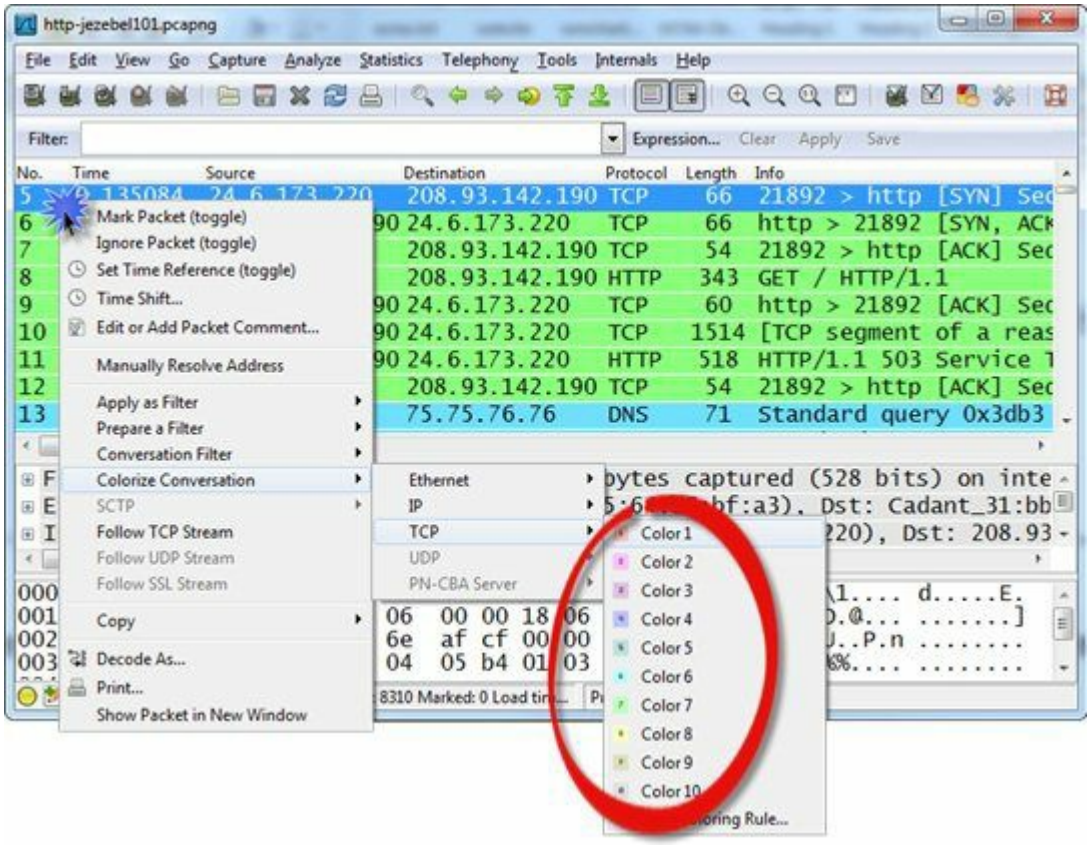
specific.

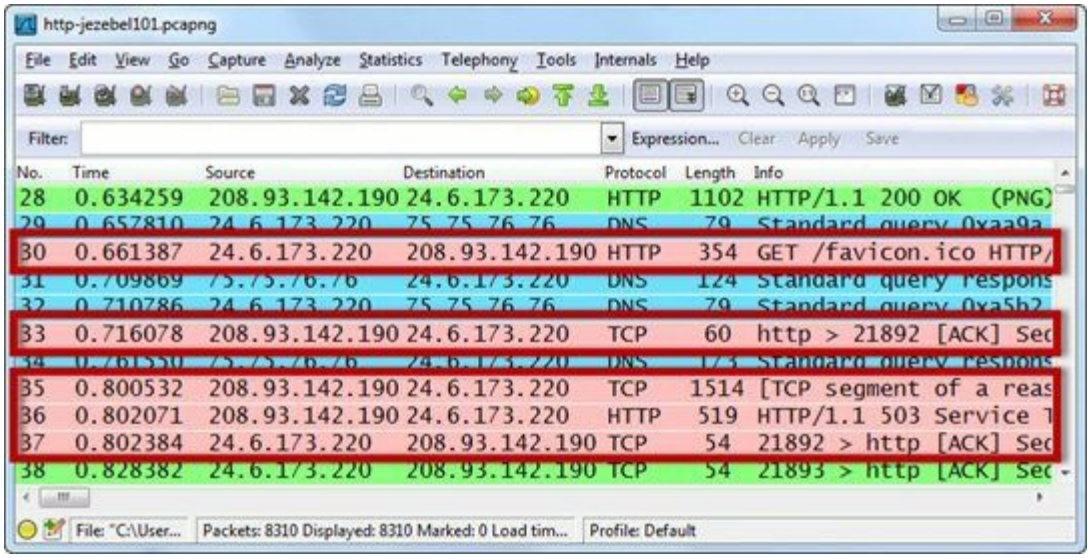
4.4. Quickly Colorize a Single Conversation

It can be confusing to analyze traffic when your network communications contain numerous

intertwined conversations. You can use coloring to visibly separate the conversations in the Packet

List pane to differentiate them as you scroll through a trace file.




http-jezebel101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
28 0.634259 208.93.142.190 24.6.173.220 HTTP 1102 HTTP/1.1 200 OK (PNG)
30 0.661387 24.6.173.220 208.93.142.190 HTTP 354 GET /favicon.ico HTTP/
33 0.716078 208.93.142.190 24.6.173.220 TCP 60 http > 21892 [ACK] Seq
35 0.800532 208.93.142.190 24.6.173.220 TCP 1514 [TCP segment of a reas
36 0.802071 208.93.142.190 24.6.173.220 HTTP 519 HTTP/1.1 503 Service
37 0.802384 24.6.173.220 208.93.142.190 TCP 54 21892 > http [ACK] Seq
38 0.828382 24.6.173.220 208.93.142.190 TCP 54 21893 > http [ACK] Seq
File: "C:\User... Packets: 8310 Displayed: 8310 Marked: 0 Load tim... Profile: Default

Right-Click to Temporarily Colorize a Conversation

To temporarily colorize a TCP conversation, right-click on any conversation in the Packet List pane

and select **Colorize Conversation | TCP | Color 1**, as shown in Figure 87. Wireshark offers ten

temporary colors. Some of the colors are quite similar and may be difficult to distinguish from each

other.

Temporary colors are retained until you change to another profile, restart Wireshark, or manually

remove them.

Figure 87. Right-click on a conversation in the Packet List pane, select the type of conversation, and choose a temporary color.

[http-jezebel101.pcapng]

In Figure 88, we applied a temporary coloring rule to the TCP conversation that was established to

download a site icon file (favicon.ico).

Figure 88. Coloring conversations helps distinguish them in a trace file. [http-jezebel101.pcapng]

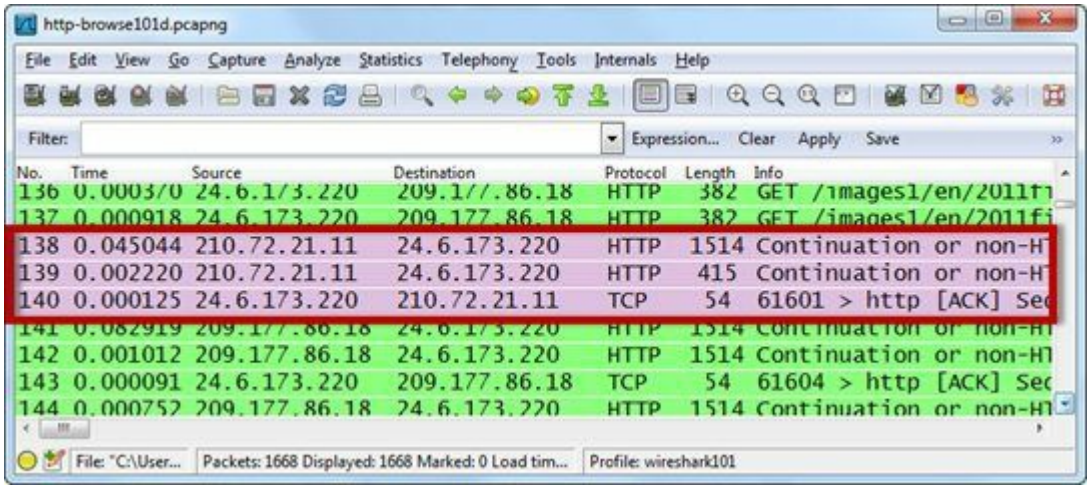
Remove Temporary Coloring

Although we refer to these coloring rules as "temporary," if you apply a temporary coloring rule to a

conversation, close the trace file, and open it again. You will notice the color is still in place.

Temporary coloring rules are in effect until you switch profiles, close Wireshark or remove them.

To remove all your temporary color settings, select **View | Reset Coloring 1-10**.


http-browse101d.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
138 0.045044 210.72.21.11 24.6.173.220 HTTP 1514 Continuation or non-HT
139 0.002220 210.72.21.11 24.6.173.220 HTTP 415 Continuation or non-HT
140 0.000125 24.6.173.220 210.72.21.11 TCP 54 61601 > http [ACK] Seq
142 0.001012 209.177.86.18 24.6.173.220 HTTP 1514 Continuation or non-HT
143 0.000091 24.6.173.220 209.177.86.18 TCP 54 61604 > http [ACK] Seq
File: "C:\User... Packets: 1668 Displayed: 1668 Marked: 0 Load tim... Profile: wireshark101

Lab 28: Create Temporary Conversation Coloring Rules

In this lab, you will apply three temporary coloring rules to differentiate TCP conversations. When

you scroll through the trace file, you will be able to easily see when an earlier conversation begins to

surface.

Step 1: Open ***http-browse101d.pcapng***.

Step 2: Frame 1 is a TCP handshake packet (SYN). Right-click on **frame 1** in the Packet List pane and select **Colorize Conversation | TCP | Color 1**.

Step 3: Scroll down until you see the next SYN packet—frame 12. Right-click on **frame 12** in the

Packet List pane and select **Colorize Conversation | TCP | Color 2**.

Step 4: Scroll down until you see the next SYN packet—frame 61. Right-click on **frame 61** in the

Packet List pane and select **Colorize Conversation | TCP | Color 3**.

Step 5: Now scroll through the trace file to see if these three conversations appear later. When you get

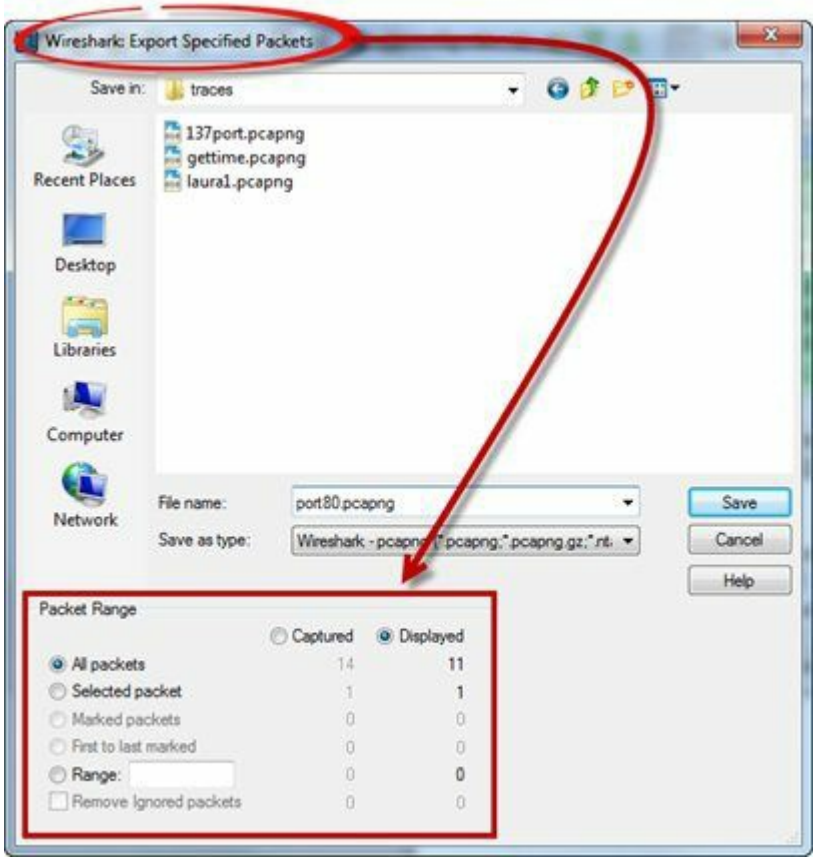
to frame 138, you will see conversation 3 appearing again.

Step 6: [Lab Clean-up] Select **View | Reset Coloring 1-10** to remove your temporary coloring rules.

This temporary coloring is very useful when analyzing applications that require many connections—

think Microsoft's SharePoint! It's easy to differentiate the various processes taking place on the

network when we colorize different conversations.



TIP

4.5. Export Packets that Interest You

When you work with a large trace file that has numerous communication types, consider applying

filters based on conversations or protocols and exporting the packets to a new trace file. You will have

fewer packets to deal with and your statistics will only apply to the exported packets.

You can easily export displayed packets, marked packets, or a range of packets.

Let's say you applied a display filter for all traffic to or from TCP port 80 (tcp.port==80). To

export these packets to a new trace file, select **File | Export Specified Packets**, as shown in Figure 89.

*Figure 89. Use **File | Export Specified Packets** to save the captured packets, displayed packets, marked packets, or a range of packets.*

If you want to export packets that do not match neatly in a display filter, consider marking the packets

before selecting **File | Export Specified Packets**. Right-click on each packet of interest in the Packet

List pane and select **Mark Packet (toggle)**. You must mark each packet separately.

By default, marked packets appear with a black background and white foreground. When you select

File | Export Specified Packets, choose either **Marked packets** or **First to last marked**.

If some of your marked packets are not visible due to a display filter, you can still export them by

clicking the **Captured** radio button.

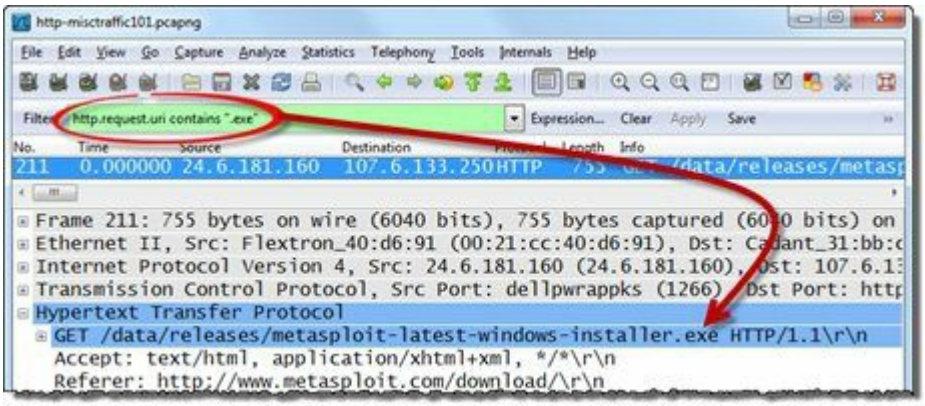
Packet marking is only temporary. When you open the exported packets in your new trace file, the

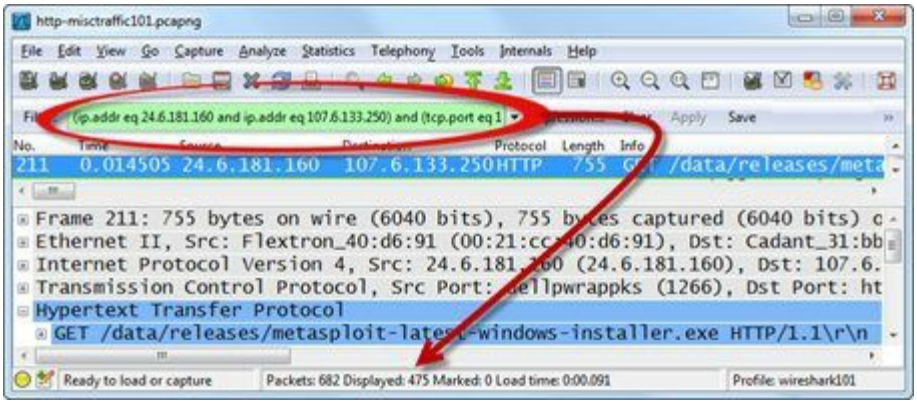
packets will not be marked.

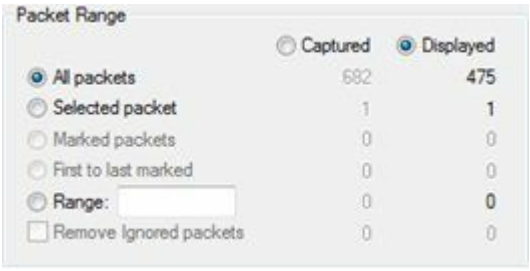
*Prior to Wireshark 1.8, we used **File | Save As** to save a subset of packets. Now Save As is*

only used to save a copy of the entire trace file or to save the trace file into another format.

*We now must select **File | Export Specified Packets** to save a subset of a trace file.*


http-misctraffic101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
http.request.uri contains ".exe"
Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
211 0.000000 24.6.181.160 107.6.133.250 HTTP 755 GET /data/releases/metasp
Frame 211: 755 bytes on wire (6040 bits), 755 bytes captured (6040 bits) on
Ethernet II, Src: Flextron_40:d6:91 (00:21:cc:40:d6:91), Dst: Cadant_31:bb:c
Internet Protocol Version 4, Src: 24.6.181.160 (24.6.181.160), Dst: 107.6.13
Transmission Control Protocol, Src Port: dellpwrappks (1266), Dst Port: http
Hypertext Transfer Protocol
GET /data/releases/metasploit-latest-windows-installer.exe HTTP/1.1\r\n
Accept: text/html, application/xhtml+xml, */*\r\n
Referer: http://www.metasploit.com/download/\r\n


http-misctraffic101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
(ip.addr eq 24.6.181.160 and ip.addr eq 107.6.133.250) and (tcp.port eq 1
Apply Save
No. Time Source Destination Protocol Length Info
211 0.014505 24.6.181.160 107.6.133.250 HTTP 755 GET /data/releases/meta
Frame 211: 755 bytes on wire (6040 bits), 755 bytes captured (6040 bits) o
Ethernet II, Src: Flextron_40:d6:91 (00:21:cc:40:d6:91), Dst: Cadant_31:bb
Internet Protocol Version 4, Src: 24.6.181.160 (24.6.181.160), Dst: 107.6.
Transmission Control Protocol, Src Port: dellpwrappks (1266), Dst Port: ht
Hypertext Transfer Protocol
GET /data/releases/metasploit-latest-windows-installer.exe HTTP/1.1\r\n
Ready to load or capture
Packets: 682 Displayed: 475 Marked: 0 Load time: 0:00.091
Profile: wireshark101



Lab 29: Export a Single TCP Conversation

When you are focused on a specific application or a specific file download, it helps to extract

conversations into separate trace files. In this lab, you will create and extract a new trace file after

locating traffic from an executable file download process.

Step 1: Open ***http-misctraffic101.pcapng***.

Step 2: Using your display filtering techniques, filter on a frame that contains ".exe" in the HTTP

Request URI field (**http.request.uri contains ".exe"**). Only one frame should match

your filter—frame 211, as shown below.

It appears someone is downloading Metasploit, a popular penetration testing program.

Step 3: Right-click on **frame 211** in the Packet List pane. Select **Conversation Filter | TCP** to display this single TCP conversation. The Status Bar should now indicate that 475 packets match your filter.

Step 4: To save this conversation in a separate trace file, select **File | Export Specified Packets**. Enter the file name ***exportexe.pcapng*** and ensure the **Displayed** radio button is selected before clicking **Save**.

Step 5: [Lab Clean-up] Click the **Clear** button to remove the conversation display filter before you continue.

You've now created a new trace file that contains a single conversation from the original trace file.

Working with a single conversation is much easier than wading through thousands of conversations in

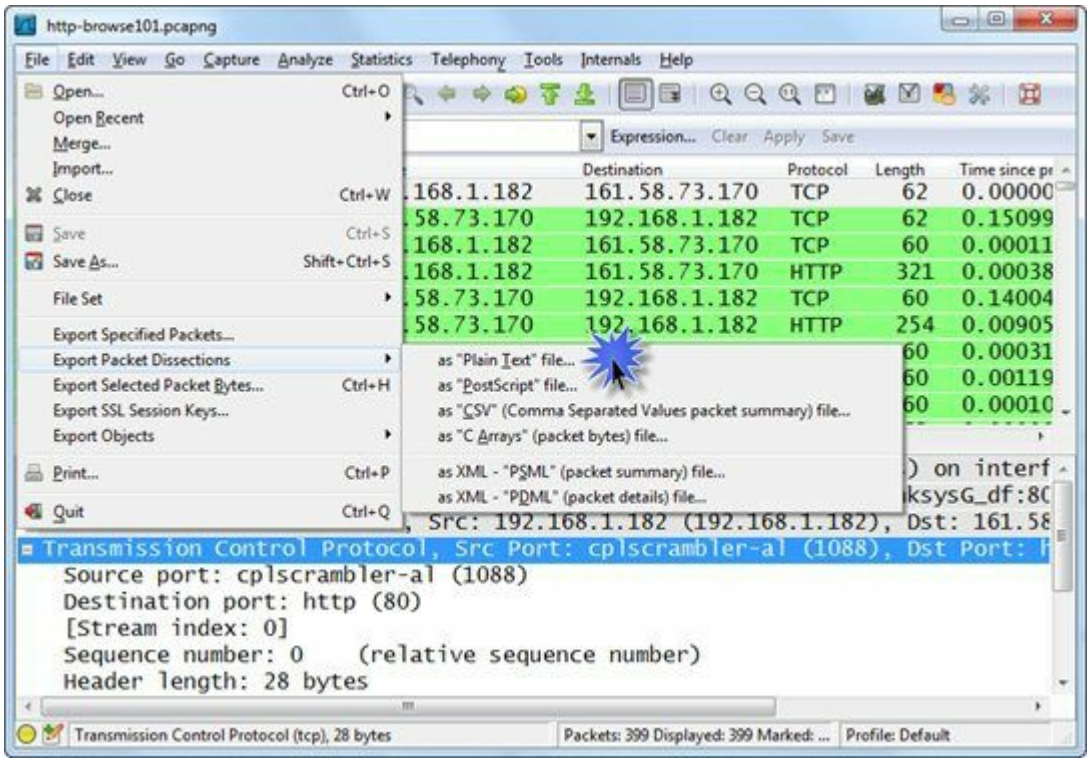
a trace file.

4.6. Export Packet Details

If you are going to write a report about network communications or packet contents, it would be nice

to show some packets along with your analysis findings. It's easy to export packet details, but be

careful you don't get too much information during the process.


http-browse101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Open... Ctrl+O
Open Recent
Merge...
Import...
Close Ctrl+W
Save Ctrl+S
Save As... Shift+Ctrl+S
File Set
Export Specified Packets...
Export Packet Dissections
Export Selected Packet Bytes... Ctrl+H
Export SSL Session Keys...
Export Objects
Print... Ctrl+P
Quit Ctrl+Q
Expression... Clear Apply Save
Destination Protocol Length Time since pr
.168.1.182 161.58.73.170 TCP 62 0.00000
.58.73.170 192.168.1.182 TCP 62 0.15099
.168.1.182 161.58.73.170 TCP 60 0.00011
.168.1.182 161.58.73.170 HTTP 321 0.00038
.58.73.170 192.168.1.182 TCP 60 0.14004
.58.73.170 192.168.1.182 HTTP 254 0.00905
as "Plain Text" file...
as "PostScript" file...
as "CSV" (Comma Separated Values packet summary) file...
as "C Arrays" (packet bytes) file...
as XML - "PSML" (packet summary) file...
as XML - "PDML" (packet details) file...
Transmission Control Protocol, Src Port: cplscrambler-al (1088), Dst Port:
Source port: cplscrambler-al (1088)
Destination port: http (80)
[Stream index: 0]
Sequence number: 0 (relative sequence number)
Header length: 28 bytes
Transmission Control Protocol (tcp), 28 bytes
Packets: 399 Displayed: 399 Marked: ...
Profile: Default

Export Packet Dissections

Select **File | Export Packet Dissections** to export packet details, as shown in Figure 90. There are six

different export options, but the most commonly used export types are plain text and CSV (comma

separated value) formats.

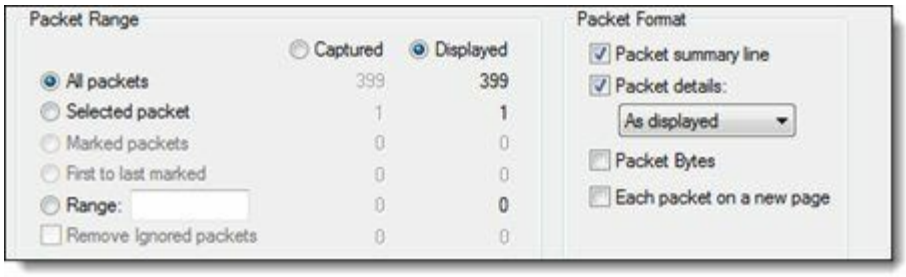
*Figure 90. To include packet details in a report, select **File | Export Packet Dissections**. [http–browse101.pcapng]*

Select the plain text format if you are going to include packet contents or summary information in a

report.

Select CSV format to import packet information into another program (such as a spreadsheet

program) for further manipulation and analysis.



Define What should be Exported

There are additional options that can be defined. You can choose to export specific packets based on

your filters or marked packets. You can also define what packet information should be included in the

output process. As shown in Figure 91, you can export the packet summary line (from the Packet List

pane, including any columns you've added), packet details (choose all expanded, as displayed in the

Packet Details pane, or all collapsed), or the packet bytes (output with hex and ASCII details).

You can also select to have each packet on a different page. Be careful—you can run through reams of

paper this way.

Practice exporting packet information to figure out which format would look best in a report.

Figure 91. Decide how much packet detail you need when exporting packet dissections.

Sample Text Output

The output below was created by exporting a single packet in plain text format (.txt) using the packet

details as displayed.

Frame 4: 321 bytes on wire (2568 bits), 321 bytes captured (2568

bits) on interface 0

Ethernet II, Src: AmbitMic_0b:b9:44 (00:d0:59:0b:b9:44), Dst:

LinksysG_df:80:c7 (00:04:5a:df:80:c7)

Internet Protocol Version 4, Src: 192.168.1.182 (192.168.1.182), Dst:

161.58.73.170 (161.58.73.170)

Transmission Control Protocol, Src Port: cplscrambler-al (1088), Dst

Port: http (80), Seq: 1, Ack: 1, Len: 267

Hypertext Transfer Protocol

GET / HTTP/1.1\r\n

Accept: */*\r\n

Accept-Language: en-us\r\n

Accept-Encoding: gzip, deflate\r\n

If-Modified-Since: Sat, 16 Mar 2002 07:16:37 GMT;

length=69556\r\n

User-Agent: Mozilla/4.0 (compatible; MSIE 5.5; Windows NT

5.0)\r\n

Host: www.packet-level.com\r\n

Connection: Keep-Alive\r\n

\r\n

[Full request URI: http://www.packet-level.com/]

Sample CSV Output

Exporting to CSV format allows you to manipulate the information in another tool, such as Excel. The

output below was created by exporting the packet summary line of all the packets of a trace file in

comma separated value format (.csv).

"No.","Time","Source","Destination","Protocol","Length","Info"

"2","0.251957000","24.6.173.220","75.75.75.75","DNS","77","Standard query 0x5451 A www.chappellu.com"

"3","1.252833000","24.6.173.220","75.75.76.76","DNS","77","Standard query 0x5451 A www.chappellu.com"

"4","1.253087000","24.6.173.220","75.75.75.75","DNS","77","Standard query 0x5451 A www.chappellu.com"

"5","2.252841000","24.6.173.220","75.75.76.76","DNS","77","Standard query 0x5451 A www.chappellu.com"

"6","2.252903000","24.6.173.220","75.75.75.75","DNS","77","Standard query 0x5451 A www.chappellu.com"

"8","4.252909000","24.6.173.220","75.75.75.75","DNS","77","Standard query 0x5451 A www.chappellu.com"

"9","4.252977000","24.6.173.220","75.75.76.76","DNS","77","Standard query 0x5451 A www.chappellu.com"

"10","8.253355000","24.6.173.220","75.75.75.75","DNS","77","Standard query 0x5451 A www.chappellu.com"

"11","8.253600000","24.6.173.220","75.75.76.76","DNS","77","Standard query 0x5451 A www.chappellu.com"

"12","8.298331000","75.75.75.75","24.6.173.220","DNS","93","Standard query response 0x5451 A 198.66.239.146"

"24","8.449268000","24.6.173.220","75.75.75.75","DNS","84","Standard query 0xc16e A www.google-analytics.com"

"25","8.465908000","75.75.75.75","24.6.173.220","DNS","304","Standard query response 0xc16e CNAME www-google-

analytics.l.google.com A

74.125.224.128 A 74.125.224.130 A 74.125.224.133 A 74.125.224.129 A

74.125.224.142 A 74.125.224.131 A 74.125.224.135 A 74.125.224.132 A

74.125.224.137 A 74.125.224.134 A 74.125.224.136"

"26","8.466750000","24.6.173.220","75.75.75.75","DNS","84","Standard query 0x9111 AAAA www.google-analytics.com"

"27","8.478874000","75.75.75.75","24.6.173.220","DNS","156","Standard query response 0x9111 CNAME www-google-analytics.l.google.com AAAA

2001:4860:4001:803::1006"

Before you export the Packet Summary information, right-click on any column heading and

*select **Displayed Columns** to check for hidden columns. Hidden columns will automatically*

be included in the exported file. You might like this behavior because you can export large

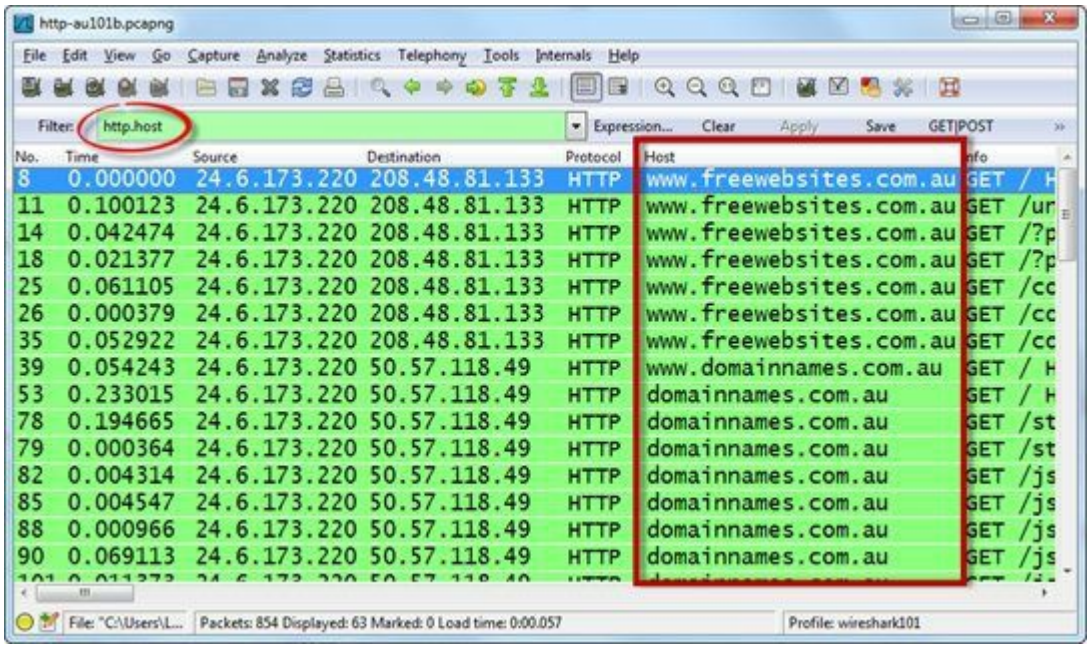
amounts of column data without having all the columns visible as you work. Keep in mind,

however, that more columns means more work for Wireshark when it opens and displays

files, applies display filters, and sets coloring rules. If you don't want these columns exported,

you must remove them. The fastest way to remove a large number of unwanted columns is

through ***Edit | Preferences | Columns****.*


http-au101b.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: http.host
Expression... Clear Apply Save GET|POST
No. Time Source Destination Protocol Host
8 0.000000 24.6.173.220 208.48.81.133 HTTP www.freewebsites.com.au
11 0.100123 24.6.173.220 208.48.81.133 HTTP www.freewebsites.com.au
14 0.042474 24.6.173.220 208.48.81.133 HTTP www.freewebsites.com.au
18 0.021377 24.6.173.220 208.48.81.133 HTTP www.freewebsites.com.au
25 0.061105 24.6.173.220 208.48.81.133 HTTP www.freewebsites.com.au
26 0.000379 24.6.173.220 208.48.81.133 HTTP www.freewebsites.com.au
35 0.052922 24.6.173.220 208.48.81.133 HTTP www.freewebsites.com.au
39 0.054243 24.6.173.220 50.57.118.49 HTTP www.domainnames.com.au
53 0.233015 24.6.173.220 50.57.118.49 HTTP domainnames.com.au
78 0.194665 24.6.173.220 50.57.118.49 HTTP domainnames.com.au
79 0.000364 24.6.173.220 50.57.118.49 HTTP domainnames.com.au
82 0.004314 24.6.173.220 50.57.118.49 HTTP domainnames.com.au
85 0.004547 24.6.173.220 50.57.118.49 HTTP domainnames.com.au
88 0.000966 24.6.173.220 50.57.118.49 HTTP domainnames.com.au
90 0.069113 24.6.173.220 50.57.118.49 HTTP domainnames.com.au
Packets: 854 Displayed: 63 Marked: 0 Load time: 0:00.057
Profile: wireshark101

Lab 30: Export a List of HTTP Host Field Values from a

Trace File

In this lab, you will alter the Packet List pane to display the HTTP Host field before exporting

information to CSV format.

Step 1: Open ***http-au101b.pcapng***.

Step 2: In Lab 15 you created an HTTP **Host** column. The column may be hidden right now. Right-

click on any column heading in the Packet List pane and select **Displayed Column | Host (http.host)**.

If you did not retain your HTTP **Host** column in Lab 15, right-click the **Hypertext Transfer Protocol**

section in the Packet Details pane of **frame 8** and select **Expand Subtrees**. Right-click on the **Host** field and select **Apply as Column**. You may need to adjust the new **Host** column width to see the full host name.

Step 3: Enter **http.host** as a display filter and click **Apply**. Only packets that contain this field are displayed. Those are the only packets we want to export in this lab.

Note that all Packet List pane column information (even information in hidden columns) will be

exported. Keep this in mind before adding and hiding lots of columns that you never use. Instead of

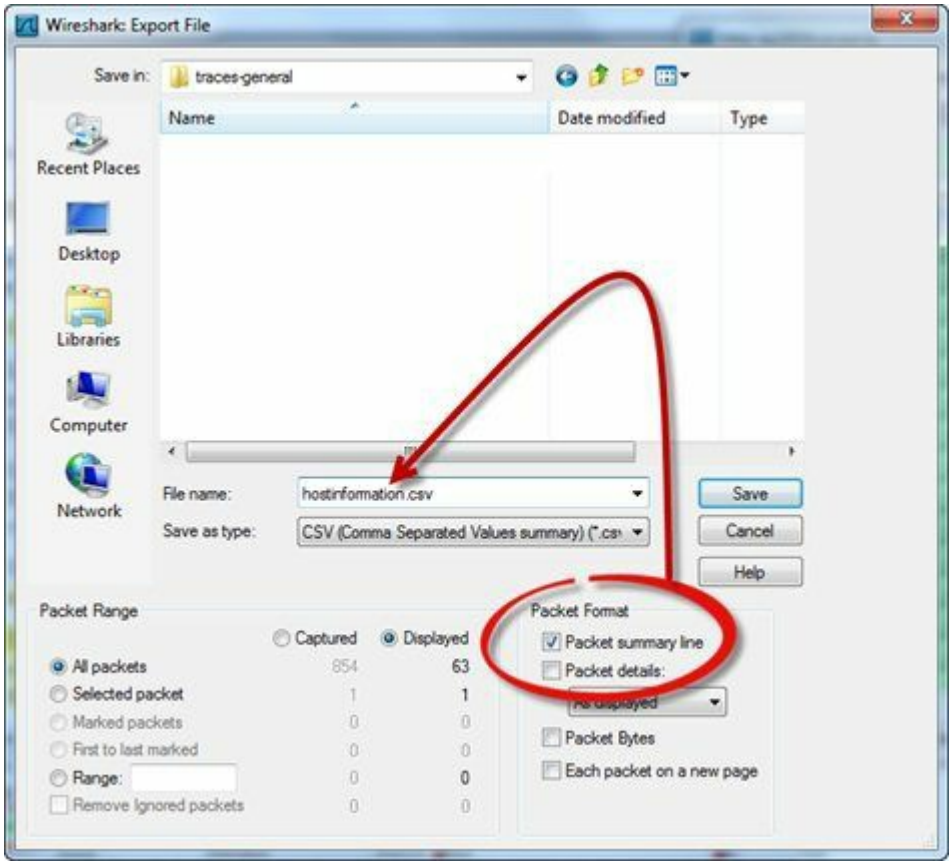
hiding these columns, use **Remove Column** to delete unwanted columns.

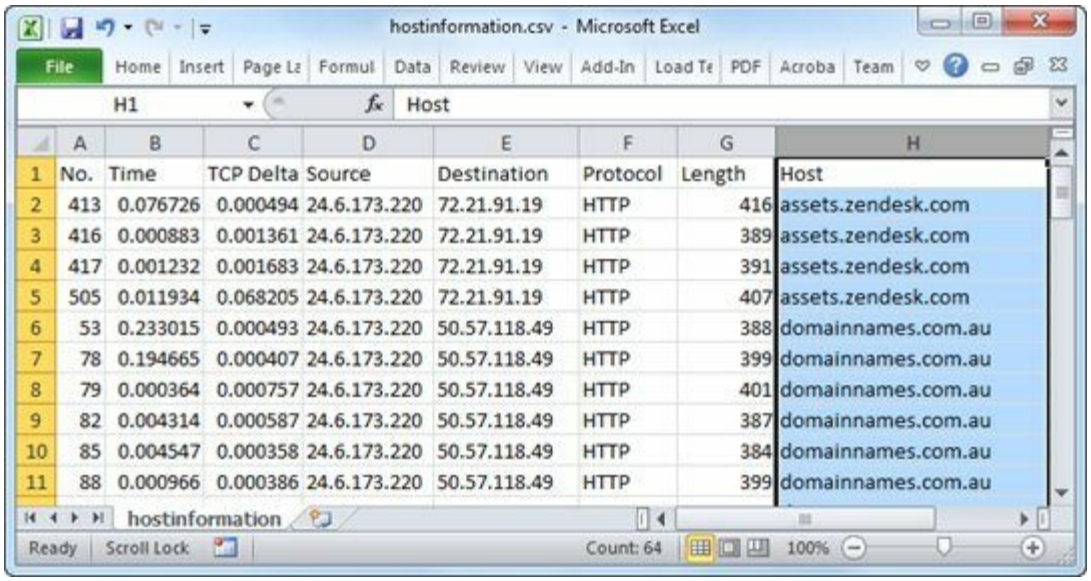
Step 4: Select **File | Export Specified Packets | as "CSV" (Comma Separated Values packet**

summary) file...

Step 5: *Displayed* is already selected in the Export File window.

Enter ***hostinformation.csv*** in the File Name field and uncheck **Packet Details**. Click **Save**.





TIP

Step 6: Open your file in a spreadsheet program (such as Excel) and sort on the **Host** column to view a list of all HTTP Host field values seen in the trace file.

Step 7: [Lab Clean-up] Return to Wireshark and click the **Clear** button to remove your http.host

filter. Right-click on the **Host** column heading and select **Hide Column**.

There are many charts and graphs that cannot be created directly in Wireshark. Exporting the desired

fields to a third-party program opens up numerous options for visualizing the traffic.

In Chapter 8, you will learn how to export the HTTP hosts list quickly using the command-line

tool Tshark.

Chapter 4 Challenge

Open *challenge101-4.pcapng* and use your packet coloring and export skills in this chapter to answer

these Challenge questions. The answer key is located in Appendix A.

Question 4-1.

What coloring rule does frame 170 match?

Question 4-2.

Temporarily color TCP stream 5 with a light blue background and apply a filter on this traffic. How

many packets match your filter?

Question 4-3.

Create and apply a coloring rule for TCP delta delays greater than 100 seconds. How many frames

match this coloring rule?

Question 4-4.

Export this filtered TCP delta information in CSV format. Using a spreadsheet program, what is the

average TCP delta time?

Chapter 5 Skills: Build and Interpret Tables

and Graphs

"When people ask me why they should use Wireshark, even when they don't have much network

protocol knowledge, I tell them to compare Wireshark to an X-ray image. Anyone who sees a pair of

scissors on an X-ray image of a person's stomach can tell you what's wrong. There shouldn't be any

scissors there.

In Wireshark, there are also things that stand out, like not getting a DNS response or seeing a TCP

SYN followed by a TCP RST. By looking more and more at network traces (and reading about the

network protocols), you will be able to extract more information from the packets. Just like a doctor

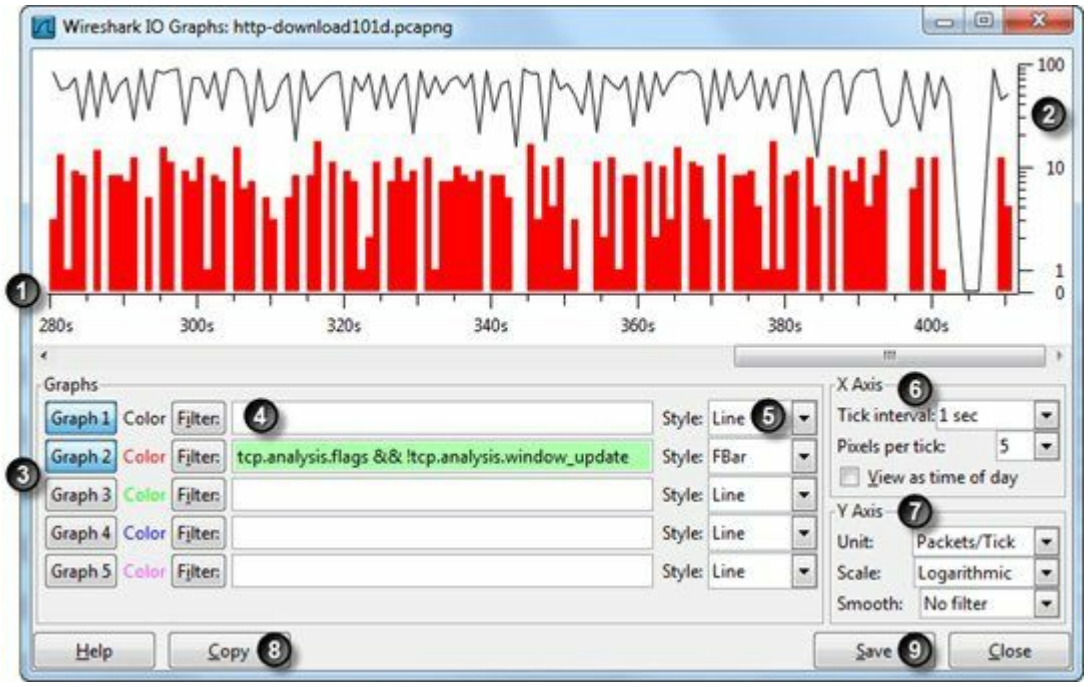
who knows what certain tissues should look like, you can extract more information from an X-ray

image than the novice eye."

Sake Blok

Wireshark Core Developer

and Founder, SYN-bit



Quick Reference: IO Graph Interface

1. **Graph area (X axis)**—The X axis defaults to seconds; scroll right/left if necessary

2. **Graph area (Y axis)**—This graph is set to a logarithmic scale[40]

3. **Graph buttons**—Click these buttons to enable/disable graph lines

4. **Filter area**—Recall saved display filters with the **Filter** button or use auto-complete when typing in filters (error detection is in use)

5. **Graph style**—Select line, impulse, fbar (floating bar), and dot formats

6. **X Axis**—Adjust the tick interval to alter the width of the graph or enable/disable the Time of Day

format for the X axis

7. **Y Axis**—Change Wireshark's default Y interval setting; access the Advanced IO Graph; enable

smoothing

8. **Copy**—Buffer the interval start and graph plot points in CSV format

9. **Save**—Save the basic graph area in .png, .bmp, .jpeg, or .tiff format

Graph 1 is in the foreground. If you are graphing multiple overlapping elements, watch for

elements (especially fbar elements) hiding other graph elements.

5.1. Find Out Who's Talking to Whom on the

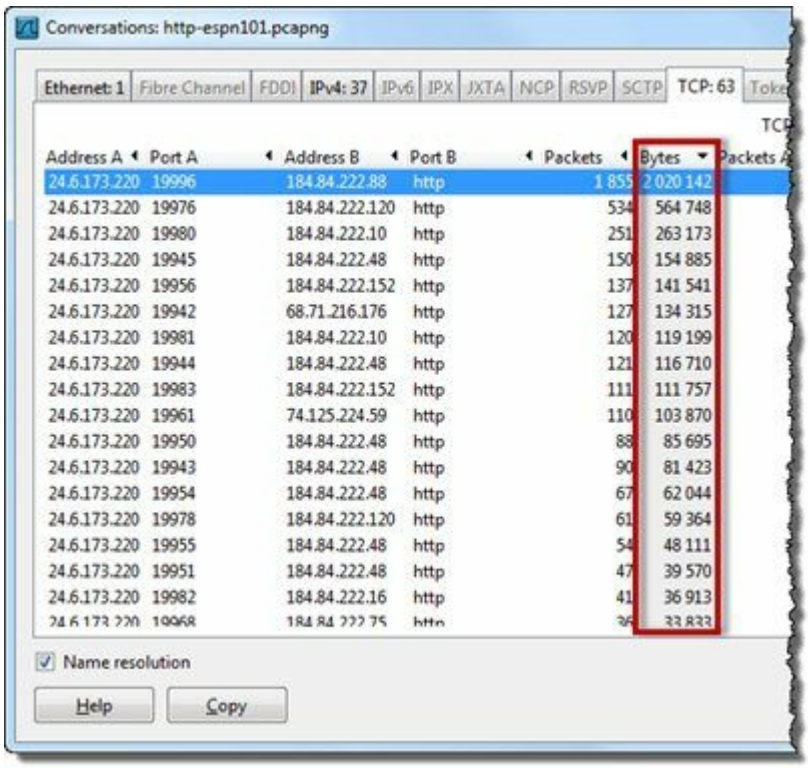
Network

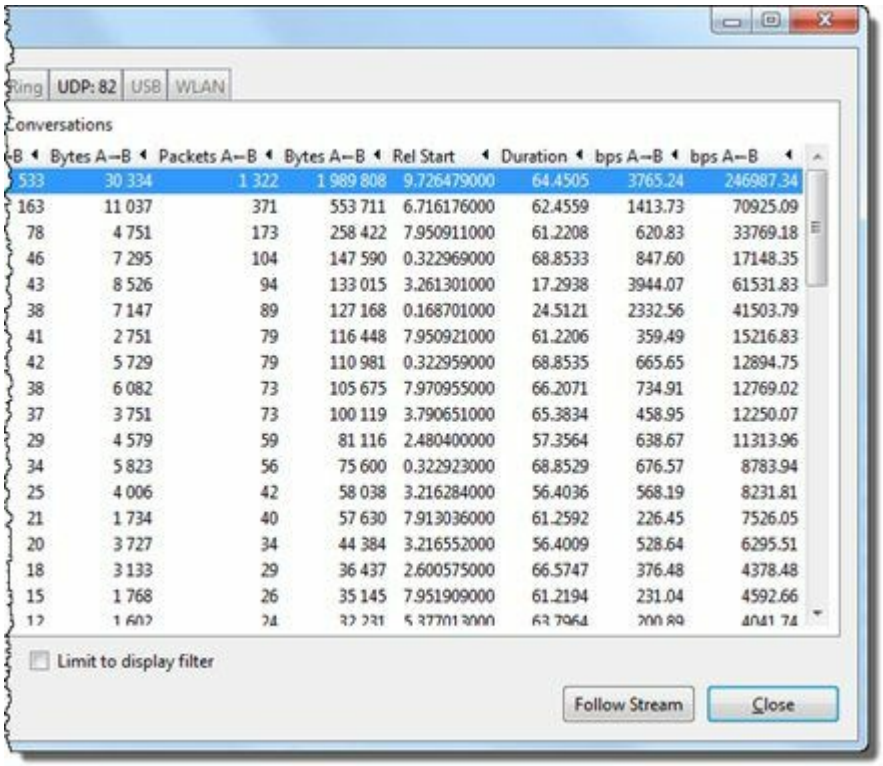
Whether you are capturing live traffic or are opening a saved trace file, you should always check to

see what hosts are communicating on the network.

There are two statistics windows available to determine what hosts are talking on the network:

Conversations and Endpoints.





Check Out Network Conversations

We opened the Conversations window in *Filter on a Conversation from Wireshark Statistics*. Select

Statistics | Conversations and expand the window to see all the columns, as shown in Figure 92 and

Figure 93.

In Figure 92, we selected the **TCP** tab and sorted the conversations based on the **Bytes** column.

*Figure 92. Select **Statistics | Conversations | TCP** to see which hosts are communicating via TCP. [http–espn101.pcapng]*

Figure 93. Expand the Conversations window to see the relative start time and duration of the conversations. [http–

espn101.pcapng]

Wireshark refers to its *services* file to replace port numbers with application names. Uncheck the

Name resolution option to turn off this resolution.

If you expand the Conversations window or scroll to the right, you will see the Relative Start (**Rel**

Start) and **Duration** columns. The Relative Start time indicates when the conversation started in the trace file. The **Duration** column indicates how much time passed from the first packet of the

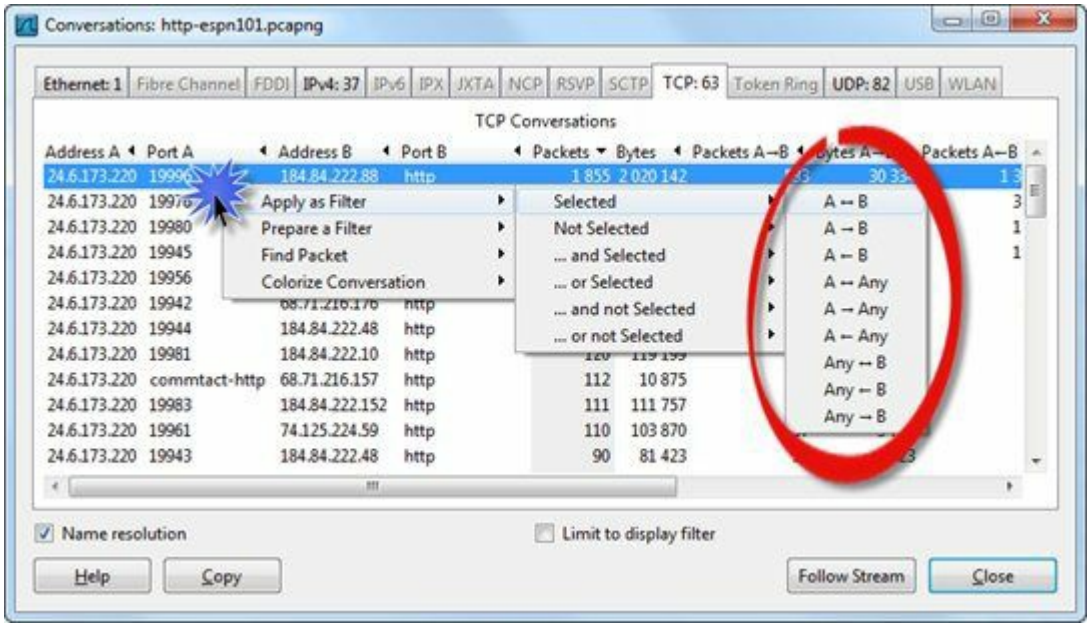
conversation to the last packet of the conversation seen in the trace file.

If you have a filter in the display filter area, you can apply that filter to the Conversations window by

checking the box in front of **Limit to display filter**.

Click **Follow Stream** (available under the **TCP** and **UDP** tabs) to reassemble the selected

conversation. This often makes it easier to understand communication between hosts.



TIP

Quickly Filter on Conversations

To filter on any conversation, right-click on a conversation and select either **Apply as Filter** or

Prepare a Filter. Unlike standard display filters, when filtering on conversations you can specify the

direction you are interested in, as shown in Figure 94.

"A" represents any column that has the "A" designation and "B" represents any column that has the

"B" designation. For example, if you click on the **IPv4** tab, you can see Address A and Address B. If you click on the **TCP** tab or **UDP** tab, you can see Address A, Port A and Address B, Port B.

Figure 94. Right-click on any conversation to apply a filter, prepare a filter, find a packet in the conversation, or to build a coloring rule for the conversation. [http–espn101.pcapng]

Remember to expand the Conversations Window. There are some very important columns

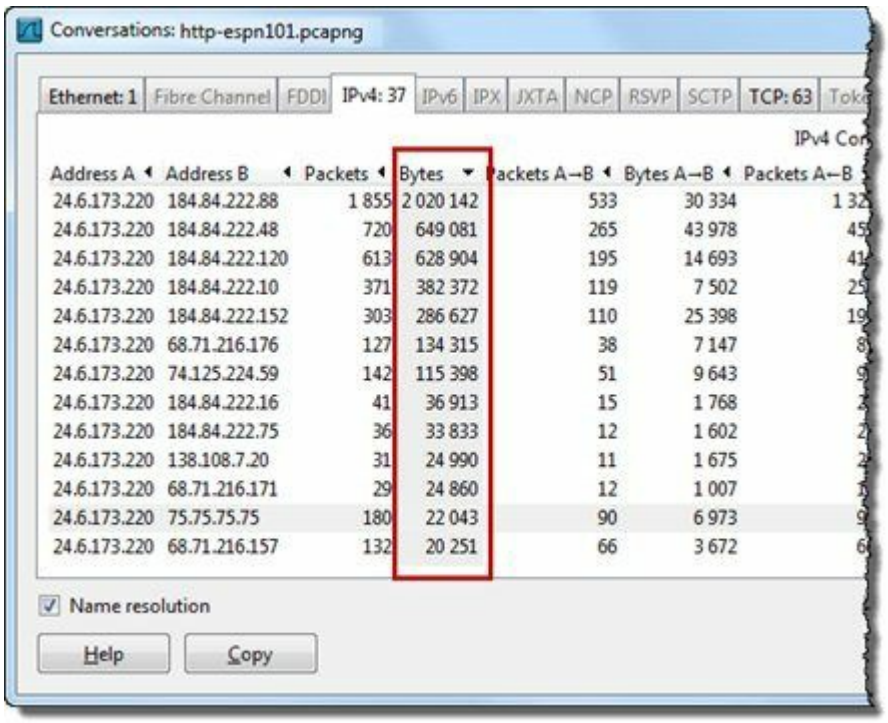
(relative time, duration, and bits per second) hidden from view on the right side when this

window opens.

5.2. Locate the Top Talkers

When you are trying to determine why a network or link is saturated with traffic, take a look at which

hosts are using the most bandwidth (based on bytes, not packets).



Sort to Find the Most Active Conversation

To determine which IPv4 or IPv6 conversations are using up the most bandwidth, select **Statistics |**

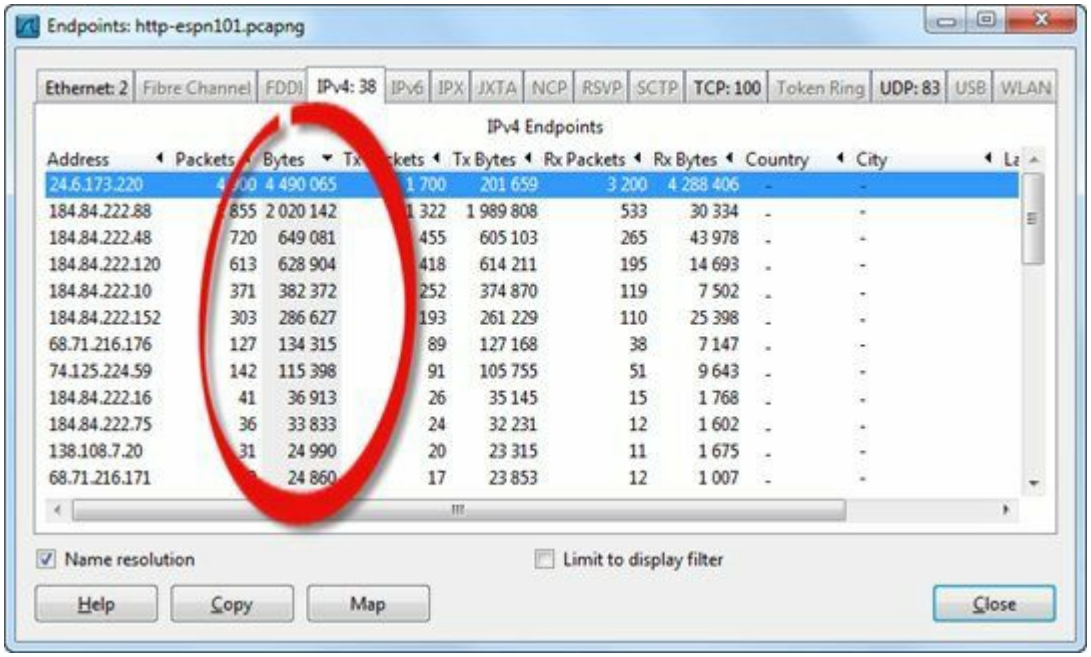
Conversations | IPv4 or **IPv6** and click twice on the **Bytes** column to sort from high to low, as shown in Figure 95.

*Figure 95. Sort on the **Bytes** column under the **IPv4** tab or **IPv6** tab to identify the most active conversations in the trace file.*

[http–espn101.pcapng]

Right-click on the top conversation line to apply or prepare a filter based on these top talkers, find a

packet in the conversation, or build a coloring rule for the conversation.



TIP

Sort to Find the Most Active Host

We need to go to another statistics window to find the top single talker on the network. Close the

Conversation window, select **Statistics | Endpoints | IPv4** or **IPv6**, and click twice on the **Bytes** column to sort from high to low, as shown in Figure 96. Since the top talker is generally based on

bandwidth usage, the **Bytes** column is the best column to use. If you are interested in the most active

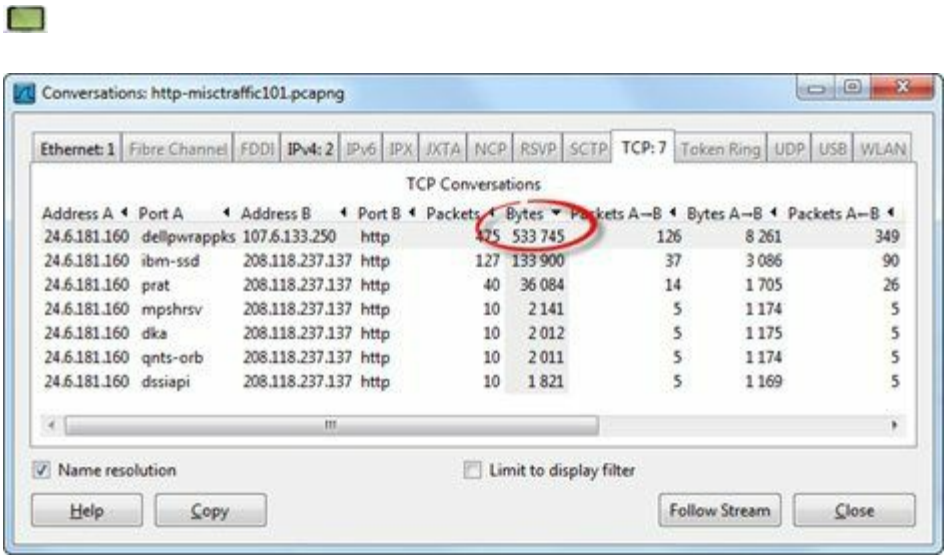
transmitter on the network, sort the **Tx Bytes** column from high to low.

*Figure 96. Sort from high to low on the **Bytes** column to find the top talker in the trace file. [http–espn101.pcapng]*

*You will see a **Map** button in the IPv4 and IPv6 sections of the Endpoints window. This button*

can be used to plot the IP addresses on a map of the world. This is called the GeoIP feature.

You will get a chance to enable/disable this feature and use this skill in Lab 32.



Lab 31: Filter on the Most Active TCP Conversation

Pulling out the most active conversation is a common network analysis task when trace files contain

tens or even hundreds of conversations.

Step 1: Open ***http-misctraffic101.pcapng***.

Step 2: Select **Statistics | Conversations**. Click the **Ethernet** tab to notice there is only one pair of hosts communicating on the local network. The MAC address listed as "Cadant" is the local router.

The "Flextron" host is the client from which we captured traffic.

Step 3: Click on the **IPv4** tab to examine the two IPv4 conversations in this trace file. Based on the bytes count, the most active IPv4 conversation is between 24.6.181.160 and 107.6.133.250.

Step 4: Click the **TCP** tab to identify the most active TCP conversation. Click twice on the **Bytes** column heading to sort from high to low.

We can see the most active TCP conversation is between 24.6.181.160 on a port listed as

"dellpwrappks" and 107.6.133.250 on a port listed as "http."

Notice that clients use a temporary port number when they communicate with an HTTP server. In this

case, the client has selected port 1266, which Wireshark lists as *dellpwrappks* in its *services* file. In this case, however, this is the port the client is using right now for its HTTP communication. It has

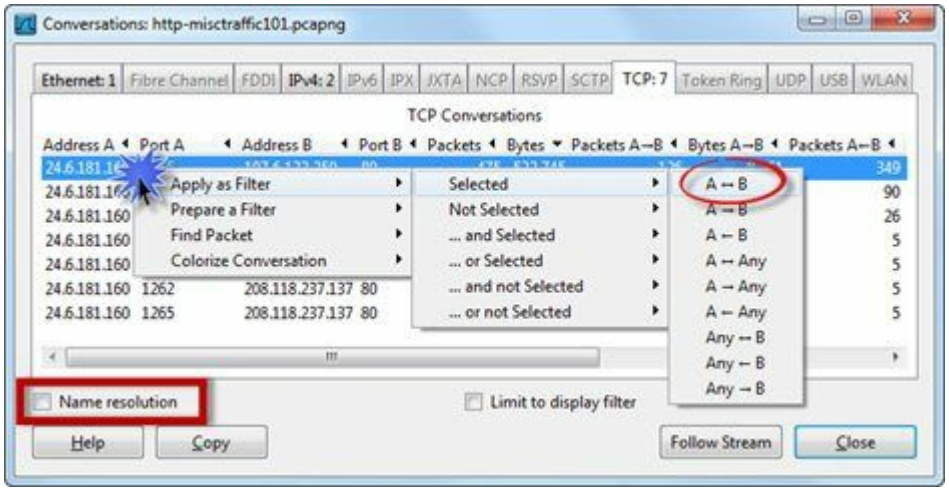
nothing to do with dellpwrappks.

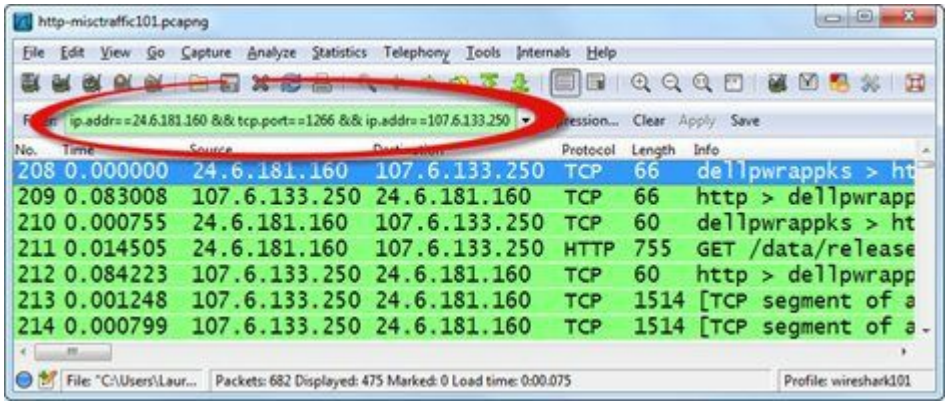
If you'd prefer to see port numbers rather than resolved port names, uncheck the **Name resolution**

checkbox on this screen.

Step 5: Right-click on the most active TCP conversation and select **Apply as Filter | Selected | A <—**

> B. Wireshark automatically creates and applies a display filter for this TCP conversation.




http-misctraffic101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
ip.addr==24.6.181.160 && tcp.port==1266 && ip.addr==107.6.133.250
Clear Apply Save
No. Time Source Destination Protocol Length Info
208 0.000000 24.6.181.160 107.6.133.250 TCP 66 dellpwrappks > ht
209 0.083008 107.6.133.250 24.6.181.160 TCP 66 http > dellpwrapp
210 0.000755 24.6.181.160 107.6.133.250 TCP 60 dellpwrappks > ht
211 0.014505 24.6.181.160 107.6.133.250 HTTP 755 GET /data/release
212 0.084223 107.6.133.250 24.6.181.160 TCP 60 http > dellpwrapp
213 0.001248 107.6.133.250 24.6.181.160 TCP 1514 [TCP segment of a
214 0.000799 107.6.133.250 24.6.181.160 TCP 1514 [TCP segment of a
File: "C:\Users\Laur...
Packets: 682 Displayed: 475 Marked: 0 Load time: 0:00.075
Profile: wireshark101

The result of this filter is shown below. There are 475 packets that match this filter.

Step 6: [Lab Clean-up] Click the **Clear** button to remove your display filter before continuing. Toggle to the Conversation window and click **Close**.

You can add other conversations to your filter easily by returning to the Conversations window, right-

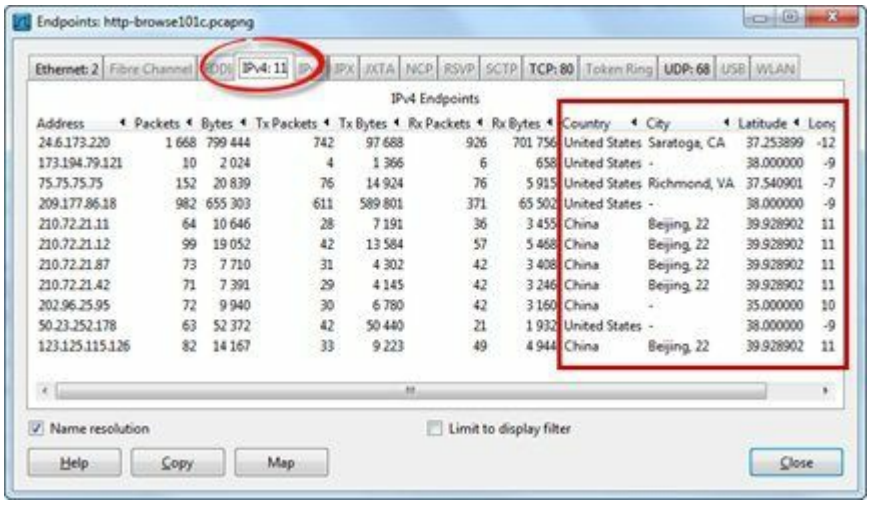
clicking on another TCP conversation and selecting **Apply as Filter | ...or Selected**. Spend some time

becoming efficient using this method for conversation filtering. You can also click the **Copy** button in

the Conversations window to buffer the current Conversations view in CSV format. You can then

paste the information into a text file, name the file with a .csv extension and open it in a spreadsheet

program to further analyze the information.



Lab 32: Set up GeoIP to Map Targets Globally

Wireshark can use the MaxMind GeoLite database files to map IPv4 and IPv6 addresses on a map of

the Earth. In this lab, you will configure Wireshark to use this database and map IP addresses seen in a

trace file.

Step 1: Open ***http-browse101c.pcapng***.

Step 2: Visit ***www.maxmind.com*** and download the free GeoLite database files (geo*.dat files). These files can be found by clicking the link to the GeoIP databases and services link and looking for the

GeoLite database files link[41].

Step 3: To enable the GeoIP feature, create a directory called ***maxmind*** on your drive and place the *maxmind* files in that directory. Now select **Edit | Preferences | Name Resolution** and click the GeoIP

database directories **Edit** button.

Click **New** and point to your ***maxmind*** directory. Continue to click **OK** until you have closed the GeoIP database paths windows and the Preferences window.

Note*: You may need to restart Wireshark in order to view GeoIP information.*

Step 4: Select **Statistics | Endpoints** and click on the **IPv4** tab. You should see information in the **Country**, **City**, **Latitude**, and **Longitude** columns.

Step 5: Click the **Map** button. Wireshark will launch a global view in your browser with the known IP

address points plotted on the map. This process uses ActiveX, which may require that you allow the

ActiveX process to run. Click on any of the plot points find more information about the IP address.

Step 6: Close the browser window when you are finished. Spend some time capturing your own traffic

and mapping it globally. Learn where your packets are traveling.

GeoIP mapping is very helpful when you are concerned about the external destination of your traffic.

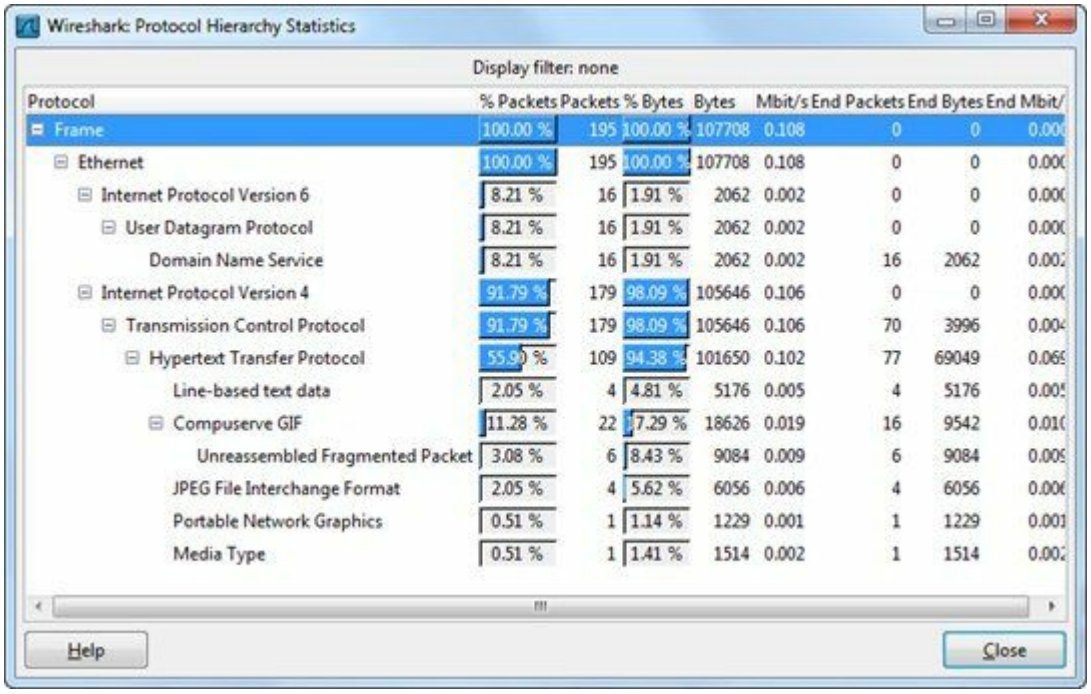
For example, if you work at a facility that should not have outbound traffic leaving the country, GeoIP

maps can help identify unwanted external targets.

5.3. List Applications Seen on the Network

If you are concerned about the type of traffic flowing over a network (perhaps you suspect a host is

compromised), use Wireshark to characterize TCP- and UDP-based applications.


Wireshark: Protocol Hierarchy Statistics
Display filter: none
Protocol % Packets Packets % Bytes Bytes Mbit/s End Packets End Bytes End Mbit/
Frame 100.00 % 195 100.00 % 107708 0.108 0 0
Ethernet 100.00 % 195 100.00 % 107708 0.108 0 0
Internet Protocol Version 6 8.21 % 16 1.91 % 2062 0.002 0 0
User Datagram Protocol 8.21 % 16 1.91 % 2062 0.002 0 0
Domain Name Service 8.21 % 16 1.91 % 2062 0.002 16 2062
Internet Protocol Version 4 91.79 % 179 98.09 % 105646 0.106 0 0
Transmission Control Protocol 91.79 % 179 98.09 % 105646 0.106 70 3996
Hypertext Transfer Protocol 55.90 % 109 94.38 % 101650 0.102 77 69049
Line-based text data 2.05 % 4 4.81 % 5176 0.005 4 5176
Compuserve GIF 11.28 % 22 7.29 % 18626 0.019 16 9542
Unreassembled Fragmented Packet 3.08 % 6 8.43 % 9084 0.009 6 9084
JPEG File Interchange Format 2.05 % 4 5.62 % 6056 0.006 4 6056
Portable Network Graphics 0.51 % 1 1.14 % 1229 0.001 1 1229
Media Type 0.51 % 1 1.41 % 1514 0.002 1 1514
Help
Close

View the Protocol Hierarchy

Select **Statistics | Protocol Hierarchy** to determine which protocols and applications are in a trace

file. In Figure 97, we opened *http-browse101b.pcapng*. We can see this trace file contains IPv4 and

IPv6 traffic. There is only UDP traffic running over IPv6 and only TCP traffic running over IPv4.

You cannot sort or reorder items in the Protocol Hierarchy because of the hierarchical structure of the

list.

Figure 97. Wireshark creates a hierarchical view of the protocols and applications seen in the trace file. [http–

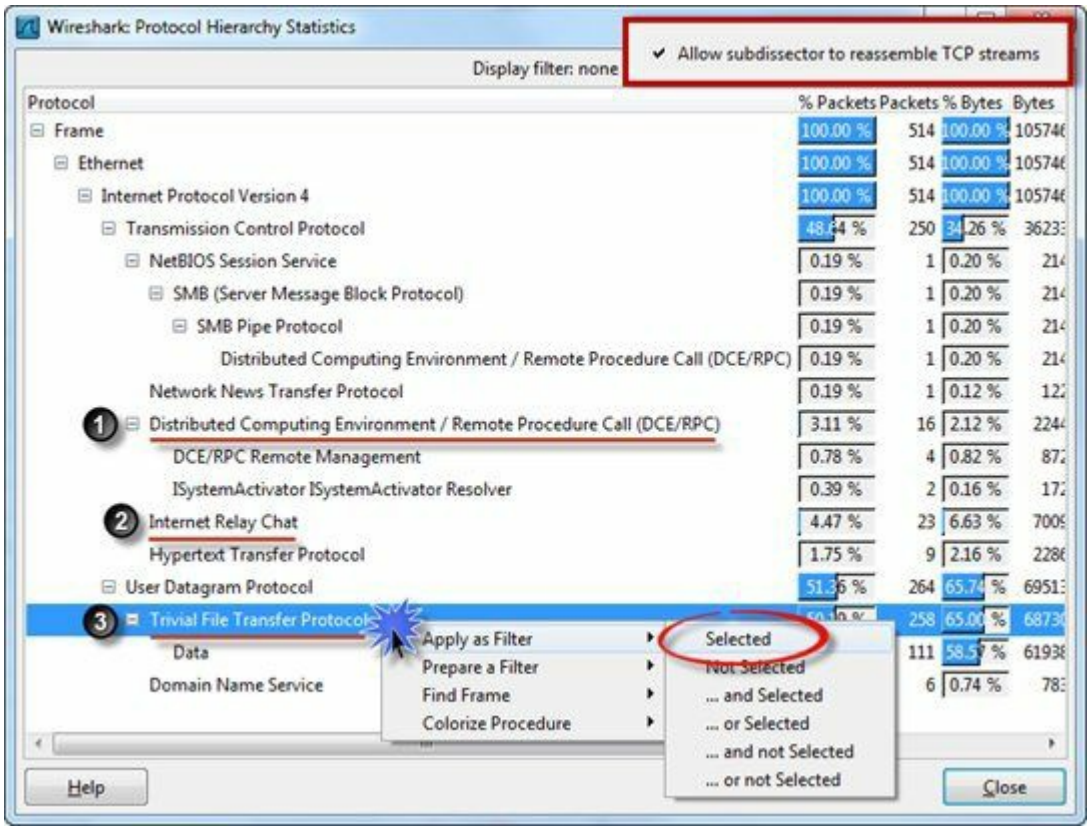
browse101b.pcapng]

Right-Click Filter or Colorize any Listed Protocol or

Application

To perform further research on any type of traffic shown, right-click on a line and select **Apply as**

Filter or **Prepare a Filter**. You can also use right-click to build a coloring rule based on a protocol or application.



Look for Suspicious Protocols, Applications or "Data"

This is a great window to examine when you think a host may be compromised. For example, this

window would help you identify unusual network applications, such as (1) Distributed Computing

Environment/Remote Procedure Call (DCE/RPC) traffic directly under TCP, (2) Internet Relay Chat

(IRC) traffic, or (3) Trivial File Transfer Protocol (TFTP) traffic, as shown in Figure 98. When you

see this suspicious traffic, right-click to filter on the traffic and examine the traffic to determine if it

is malicious[42].

"Data" listed directly under TCP or UDP in the Protocol Hierarchy window indicates that Wireshark

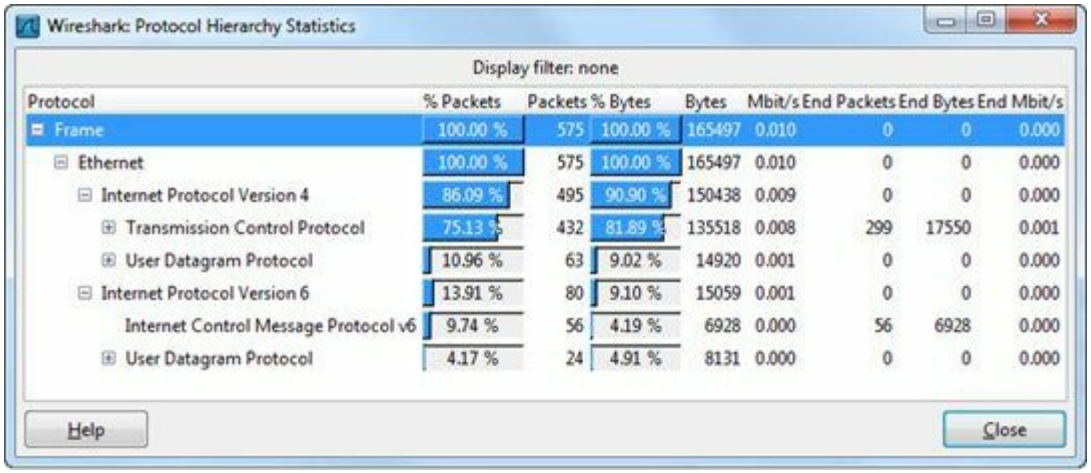
could not apply a dissector to the traffic because it does not recognize the port number and no

heuristic dissector matched the packets. Note that we enabled the *Allow the subdissector to reassemble*

TCP streams TCP preference before opening the Protocol Hierarchy window. This gives a cleaner

picture of the protocols in use.

Figure 98. Look for unusual applications or the word "data" directly under TCP or UDP. [sec–concern101.pcapng]


Wireshark: Protocol Hierarchy Statistics
Display filter: none
Protocol % Packets Packets % Bytes Bytes Mbit/s End Packets End Bytes End Mbit/s
Frame 100.00 % 575 100.00 % 165497 0.010 0 0 0.000
Ethernet 100.00 % 575 100.00 % 165497 0.010 0 0 0.000
Internet Protocol Version 4 86.09 % 495 90.90 % 150438 0.009 0 0 0.000
Transmission Control Protocol 75.13 % 432 81.89 % 135518 0.008 299 17550 0.001
User Datagram Protocol 10.96 % 63 9.02 % 14920 0.001 0 0 0.000
Internet Protocol Version 6 13.91 % 80 9.10 % 15059 0.001 0 0 0.000
Internet Control Message Protocol v6 9.74 % 56 4.19 % 6928 0.000 56 6928 0.000
User Datagram Protocol 4.17 % 24 4.91 % 8131 0.000 0 0 0.000
Help
Close

Decipher the Protocol Hierarchy Percentages

The **% Packets** and **% Bytes** column values can be confusing. The percentages shown in these two

columns are percentages of the total traffic, regardless of how deep we are in the protocol hierarchy.

Figure 99 shows the Protocol Hierarchy window for *general101b.pcapng*. "Internet Control Messaging

Protocol v6" is shown as 9.74%. That is 9.74% of the total traffic, not 9.74% of the parent protocol,

IPv6.

Sometimes it helps to collapse the Transmission Control Protocol and User Datagram Protocol

sections to see how the percentages relate to the total value.

Based on the **% Packets** column, we can see that 86.09% of the total traffic in this trace file is IPv4-

based traffic and only 13.91% of the packets in this trace file is IPv6-based traffic.

Of the total traffic, 75.13% of the total packets use TCP and 10.96% are UDP-over-IPv4 and 4.17%

are UDP-over-IPv6. Another 9.74% of packets are ICMP. Add these together and you have accounted

for 100% of the traffic in the trace file.

Figure 99. Collapse the TCP and UDP sections to get a clear look at the basic percentages provided in the Protocol Hierarchy window. [general101b.pcapng]

In Figure 100, we expanded the Transmission Control Protocol section in the Protocol Hierarchy

window. This indicates that 2.09% of the total traffic is Hypertext Transfer Protocol, 2.09% of the

total traffic is Dropbox LAN sync Protocol and 18.96% of the traffic is Secure Sockets Layer traffic.

This only accounts for 23.14% of the total traffic.

Here's where the Protocol Hierarchy window can become confusing.

If 75.13% of all the traffic is TCP-based, but only 23.14% is associated with these applications, where

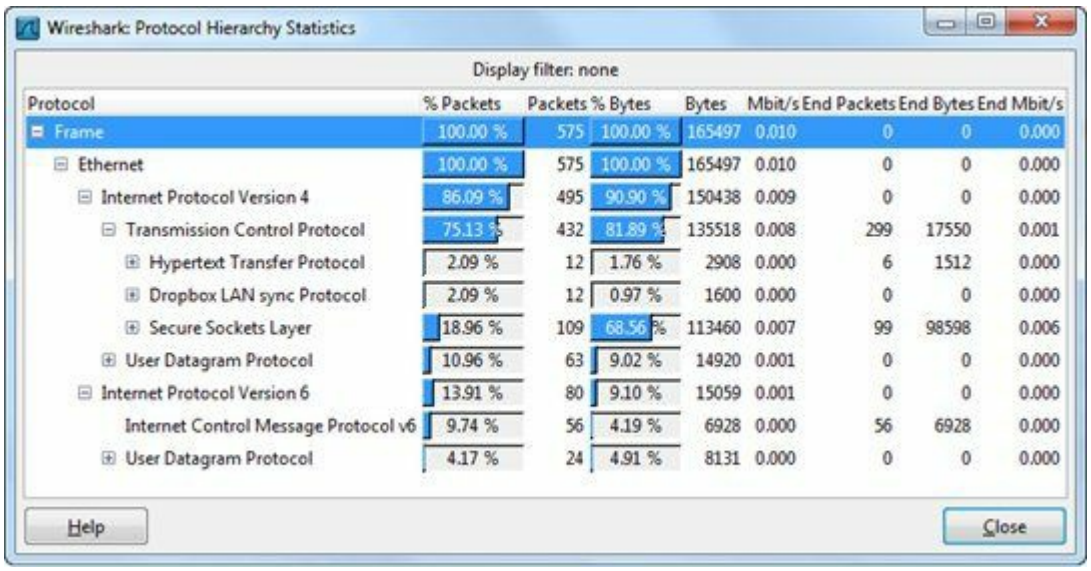
is the other 51.99% of TCP-based traffic?

Look at the **Protocol** column in the Packet List pane of *general101b.papng*. Whenever you see the

value "TCP," Wireshark does not associate that packet with a particular application—it is part of the

TCP connection establishment, acknowledgment, teardown process, etc.

We can view these TCP packets with the display filter tcp && !http && !db-lsp && !ssl.


Wireshark: Protocol Hierarchy Statistics
Display filter: none
Protocol % Packets Packets % Bytes Bytes Mbit/s End Packets End Bytes End Mbit/s
Frame 100.00 % 575 100.00 % 165497 0.010 0 0 0.000
Ethernet 100.00 % 575 100.00 % 165497 0.010 0 0 0.000
Internet Protocol Version 4 86.09 % 495 90.90 % 150438 0.009 0 0 0.000
Transmission Control Protocol 75.13 % 432 81.89 % 135518 0.008 299 17550 0.001
Hypertext Transfer Protocol 2.09 % 12 1.76 % 2908 0.000 6 1512 0.000
Dropbox LAN sync Protocol 2.09 % 12 0.97 % 1600 0.000 0 0 0.000
Secure Sockets Layer 18.96 % 109 68.56 % 113460 0.007 99 98598 0.006
User Datagram Protocol 10.96 % 63 9.02 % 14920 0.001 0 0 0.000
Internet Protocol Version 6 13.91 % 80 9.10 % 15059 0.001 0 0 0.000
Internet Control Message Protocol v6 9.74 % 56 4.19 % 6928 0.000 56 6928 0.000
User Datagram Protocol 4.17 % 24 4.91 % 8131 0.000 0 0 0.000
Help
Close

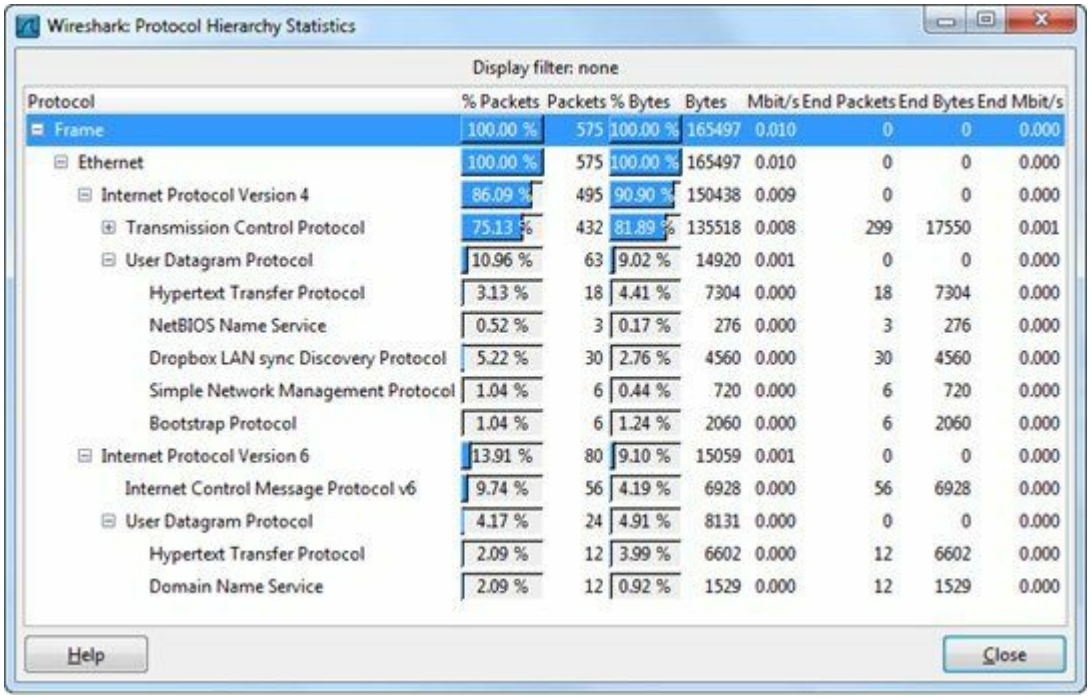

Wireshark: Protocol Hierarchy Statistics
Display filter: none
Protocol % Packets Packets % Bytes Bytes Mbit/s End Packets End Bytes End Mbit/s
Frame 100.00 % 575 100.00 % 165497 0.010 0 0 0.000
Ethernet 100.00 % 575 100.00 % 165497 0.010 0 0 0.000
Internet Protocol Version 4 86.09 % 495 90.90 % 150438 0.009 0 0 0.000
Transmission Control Protocol 75.13 % 432 81.89 % 135518 0.008 299 17550 0.001
User Datagram Protocol 10.96 % 63 9.02 % 14920 0.001 0 0 0.000
Hypertext Transfer Protocol 3.13 % 18 4.41 % 7304 0.000 18 7304 0.000
NetBIOS Name Service 0.52 % 3 0.17 % 276 0.000 3 276 0.000
Dropbox LAN sync Discovery Protocol 5.22 % 30 2.76 % 4560 0.000 30 4560 0.000
Simple Network Management Protocol 1.04 % 6 0.44 % 720 0.000 6 720 0.000
Bootstrap Protocol 1.04 % 6 1.24 % 2060 0.000 6 2060 0.000
Internet Protocol Version 6 13.91 % 80 9.10 % 15059 0.001 0 0 0.000
Internet Control Message Protocol v6 9.74 % 56 4.19 % 6928 0.000 56 6928 0.000
User Datagram Protocol 4.17 % 24 4.91 % 8131 0.000 0 0 0.000
Hypertext Transfer Protocol 2.09 % 12 3.99 % 6602 0.000 12 6602 0.000
Domain Name Service 2.09 % 12 0.92 % 1529 0.000 12 1529 0.000
Help
Close

Figure 100. The percentage values of applications listed under TCP are based on their percentage of total traffic in the trace file.

[general101b.pcapng]

In Figure 101, we collapsed the TCP section and expanded the UDP sections under the IPv4 and IPv6

sections. When we add up the % Packets value under the UDP sections, they should equal or be very

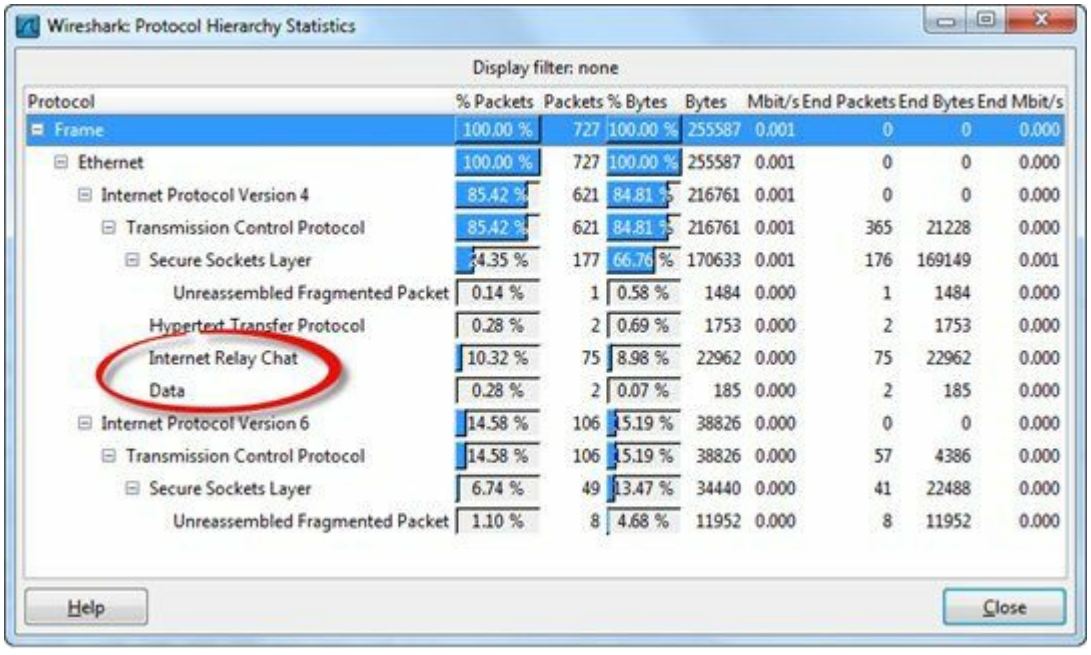
close to the total UDP value above them.

Because of numerical rounding, you may find the sum is slightly off. For example, we see

HTTP/UDP/IPv6 listed as 2.09% of total traffic and DNS/UDP/IPv6 listed as 2.09% as well. Adding

these two together gives us a total of 4.18%, however we see UDP/IPv6 listed as 4.17%.

Figure 101. The percentage values under UDP are based on their percentage of total traffic in the trace file. [general101b.pcapng]


Wireshark: Protocol Hierarchy Statistics
Display filter: none
Protocol % Packets Packets % Bytes Bytes Mbit/s End Packets End Bytes End Mbit/s
Frame 100.00 % 727 100.00 % 255587 0.001 0 0 0.000
Ethernet 100.00 % 727 100.00 % 255587 0.001 0 0 0.000
Internet Protocol Version 4 85.42 % 621 84.81 % 216761 0.001 0 0 0.000
Transmission Control Protocol 85.42 % 621 84.81 % 216761 0.001 365 21228 0.000
Secure Sockets Layer 24.35 % 177 66.76 % 170633 0.001 176 169149 0.001
Unreassembled Fragmented Packet 0.14 % 1 0.58 % 1484 0.000 1 1484 0.000
Hypertext Transfer Protocol 0.28 % 2 0.69 % 1753 0.000 2 1753 0.000
Internet Relay Chat 10.32 % 75 8.98 % 22962 0.000 75 22962 0.000
Data 0.28 % 2 0.07 % 185 0.000 2 185 0.000
Internet Protocol Version 6 14.58 % 106 15.19 % 38826 0.000 0 0 0.000
Transmission Control Protocol 14.58 % 106 15.19 % 38826 0.000 57 4386 0.000
Secure Sockets Layer 6.74 % 49 13.47 % 34440 0.000 41 22488 0.000
Unreassembled Fragmented Packet 1.10 % 8 4.68 % 11952 0.000 8 11952 0.000
Help
Close

Lab 33: Detect Suspicious Protocols or Applications

When you are concerned that there may be a security issue in your trace file, open the Protocol

Hierarchy window first. Look for suspicious applications or protocols and the dreaded "data" under IP, UDP, or TCP.

Step 1: Open ***general101c.pcapng***.

Select **Step 2**:**Statistics | Protocol Hierarchy**. This trace file contains some traffic of concern. We see Internet Relay Chat and Data under the TCP section.

Right-click on the **Step 3**:**Internet Relay Chat** line and select **Apply as Filter | Selected** to examine it further. Expand the Internet Relay Chat section in the Packet Details pane to learn more about the

communications. Look for the user name and the target IRC server. Perform the same steps to

examine the traffic listed as "data." In Chapter 6 you will revisit this file to reassemble the

communications for further analysis.

Step 4: [Lab Clean-up] Click the **Clear** button to remove any display filters. Toggle back to the

Protocol Hierarchy window to close it.

Remember to use the Protocol Hierarchy window first when you suspect malicious traffic on the

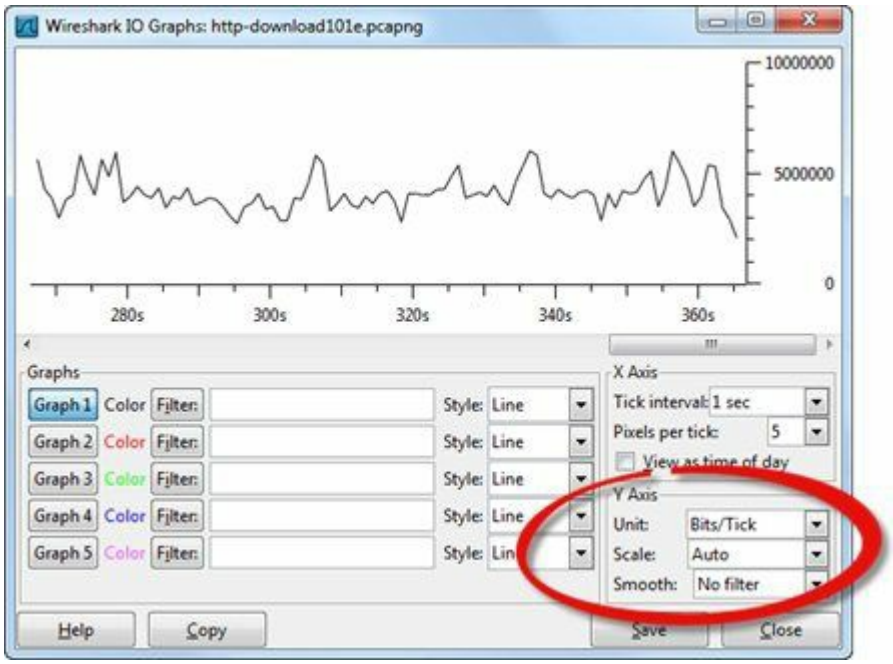
network. It's a quick way to find breached hosts.

5.4. Graph Application and Host Bandwidth

Usage

Although you can use the Protocol Hierarchy to determine the percent of total bytes or packets that an

application uses, a graph can help you analyze the flow of applications in a trace file.



Export the Application or Host Traffic before Graphing

One of the easiest ways to determine how much bandwidth an application or host is using is to filter

on that traffic type and export the traffic to a separate trace file. For example, *http–*

download101e.pcapng contains traffic to and from a single host, 24.6.173.220. This trace file was

created by exporting a host's traffic from a larger trace file.

***Note**: This is a large trace file (168 MB) and may be slow to load.*

Select **Statistics | IO Graph** to plot all the traffic in the trace file based on packets or bits. By default, Wireshark plots the packets per tick (Y axis) where each tick is one second (X axis). When we

categorize the bandwidth usage of an application, we talk about bits per second or megabits per

second. In Figure 102, we changed the Y axis to **bits/tick** (each tick being one second based on the X

axis setting). This gives us a clear view of the traffic to and from that single host. This download

process averages 5 Mbps.

Figure 102. The IO Graph shows the flow of traffic in a trace file. [http–download101e.pcapng]

If you want to compare application usage in an IO Graph, define the application traffic in the filter

areas. When you graph TCP-based applications, be sure to base your filter on a port number

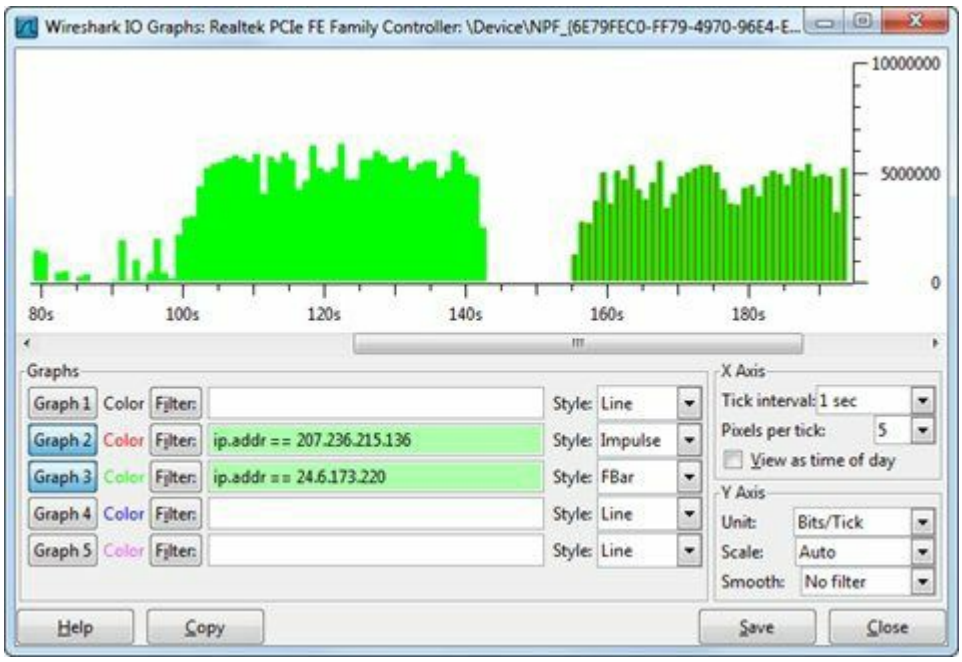
(tcp.port==80) rather than the application name to make sure you capture the connection setup

and acknowledgments. For UDP-based applications, such as DNS, you can filter based on the

application name (dns) or port number. If you are graphing a protocol, such as ICMP, simply filter on

the protocol name (icmp) and export the packets to a new trace file. We will cover applying port

filters to IO Graphs after we examine applying IP address filters to IO Graphs.



Apply ip.addr Display Filters to the IO Graph

If your trace file contains several IP conversations, you can use display filter syntax to graph the

conversation for you. Simply enter your IP address filter in one of the graph filter areas and click the

associated **Graph** button. In Figure 103, we entered two IP address filters to graph the traffic to and

from 207.236.215.136 (Graph 2) and 24.6.173.220 (Graph 3) during a live capture process. We clicked

on the **Graph 1** button to turn off that graph line. We used impulse style in Graph 2 and Fbar style in

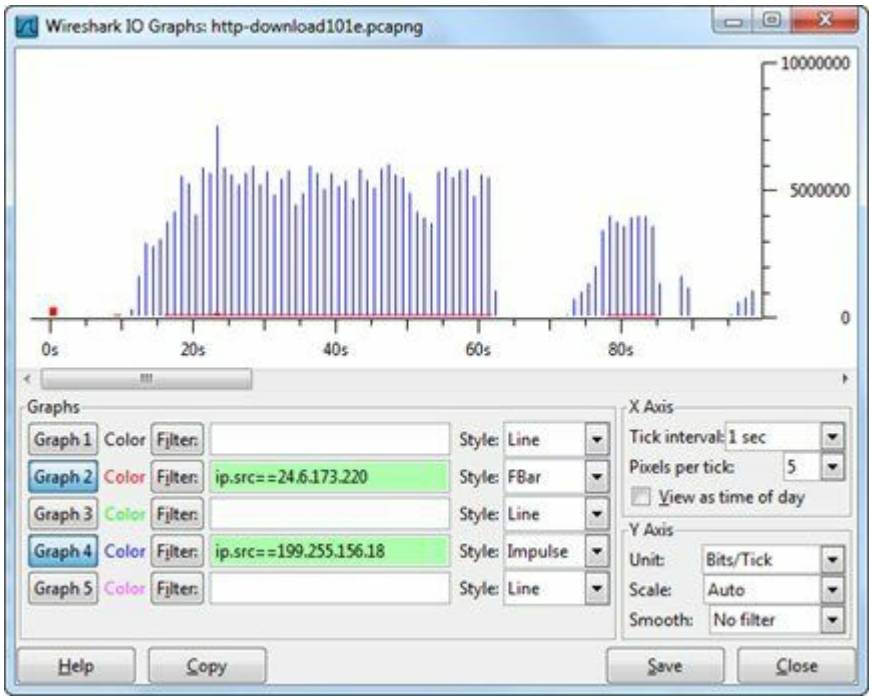
Graph 3.

This IO Graph indicates that traffic is flowing to or from 24.6.173.220 much more often than traffic is

flowing to or from 207.236.215.136. You can use this type of filtered graph to compare the traffic

rates of two or more hosts.

Figure 103. Use the IO Graph to identify trends in traffic to or from a host during a live capture process or when opening a saved trace file. [live capture process]



Apply ip.src Display Filters to the IO Graph

If you want to graph unidirectional traffic, use an ip.src , ip.dst, ipv6.src or ipv6.dst display filter.

For example, in Figure 104, we opened *http–download101e.pcapng* and launched the IO Graph. We

added two graph lines using the ip.src filter with the IP address of a client downloading a file (Graph

2) and the IP address of a server that is sending a file to this client in the trace file (Graph 4).

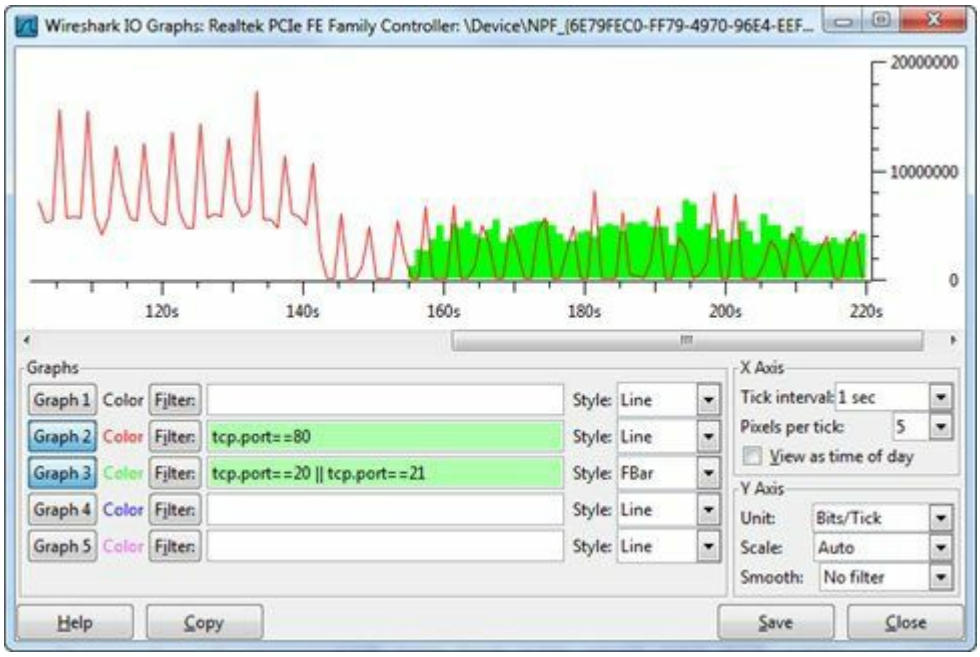
This graph indicates that 24.6.173.220 is more active at the very beginning of the trace file (as it

communicates with other servers and resolves addresses). Approximately 10 seconds into the trace

file, however, we see the majority of the traffic is transmitted by the server (199.255.156.18). In fact,

traffic from the server accounts for almost all the bits/tick graphed.

Figure 104. Using ip.src, we applied a filter to compare the traffic flowing from two different hosts. [http–download101e.pcapng]



TIP

Apply tcp.port or udp.port Display Filters to the IO Graph

If you want to compare the bandwidth use of numerous applications in a trace file, simply filter on the

port number for TCP-based applications or on the application name or port number for UDP-based

applications.

In Figure 105, we launched the IO Graph while we were running a live capture. We set the Y Axis to

Bits/Tick. To find out how much bandwidth was in use by HTTP traffic on port 80, we added a display

filter (tcp.port==80) and clicked the **Graph 2** button. We also added a filter for the

FTP command and data traffic (tcp.port==20 || tcp.port==21) and clicked the **Graph 3**

button. Finally, we clicked the **Graph 1** button to disable it. At approximately 160 seconds into the

trace file, our graph indicates that port 80 traffic decreases and port 20 and port 21 traffic increases.

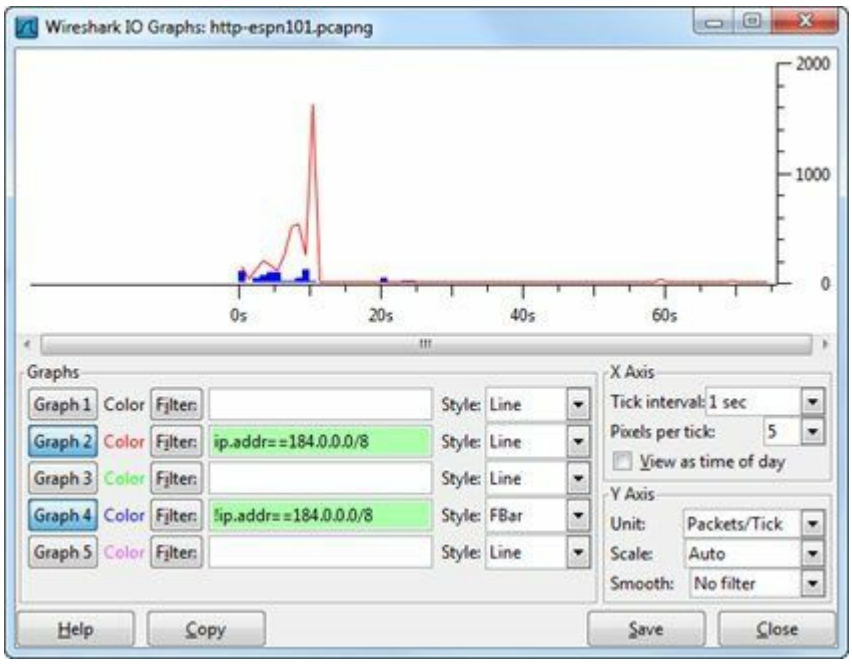
Figure 105. The IO Graph shows the flow of traffic during a live capture process or when opening a saved trace file. [live capture process]

As you add Graph 2 through Graph 5 to the IO Graph, keep in mind the order of the graph

lines. Graph 5 will be plotted farthest in the background with Graph 1 plotted in the

foreground. If you leave Graph 1 on and set it to Fbar, Graph 2 through Graph 5 may be

blocked by the Fbar if their plot values are lower than the Graph 1 plot values.



Lab 34: Compare Traffic to/from a Subnet to Other Traffic

In this lab you will compare all the traffic to or from subnet 184.0.0.0/8 to all other traffic. To do this,

you will use two IP address filters—one inclusion filter and one exclusion filter.

Step 1: Open ***http-espn101.pcapng***.

Step 2: Select **Statistics | IO Graph**.

Step 3: Click the **Graph 1** button to disable it. We will only be using Graph 2 (red) and Graph 4 (blue) to compare this traffic.

Step 4: In the filter area for Graph 2, enter ip.addr==184.0.0.0/8 and click the **Graph 2**

button.

In the filter area for Graph 4, enter !ip.addr==184.0.0.0/8, set the Graph 4 style to **Fbar** and

click the **Graph 4** button.

Step 5: [Lab Clean-up] Close your IO Graph before you move on.

If we had set the Graph 2 style to Fbar, we would not be able to see the results of Graph 4 because of

the graph ordering. This graph clearly shows that more packets go to or from subnet 184.0.0.0/8 than

to or from any other networks in this trace file.

It is easy to graph traffic to or from various subnets. Consider capturing traffic on your network to

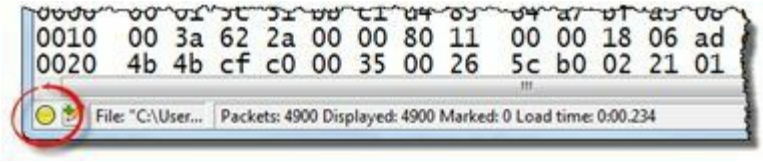
determine where it is flowing.

5.5. Identify TCP Errors on the Network

Wireshark understands many types of TCP network errors, such as packet loss and receiver

congestion. When Wireshark sees packets that indicate network problems have occurred, it makes a

note in the Expert System.



Use the Expert Infos Button on the Status Bar

We will leave the IO Graphing for a moment to view the Expert window. On the Status Bar, click on

the **Expert Infos** button. The Expert classifies information into 6 categories. The color on the **Expert**

Infos button indicates the highest layer of Expert detail seen:

Errors: red

Warnings: yellow

Notes: cyan

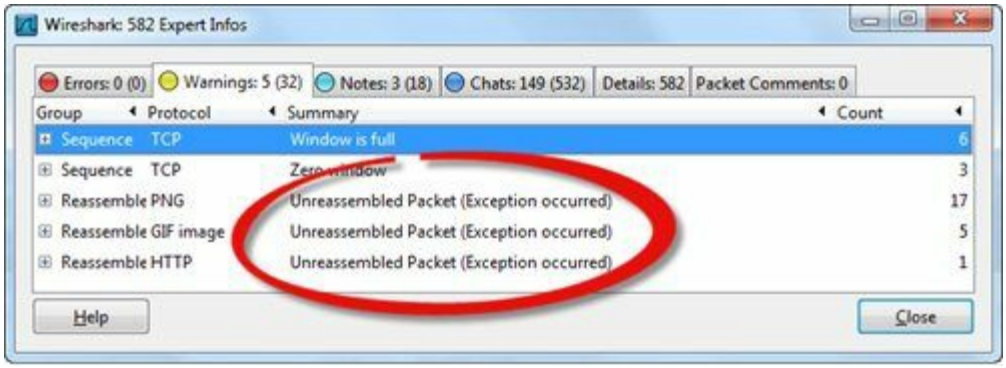
Chats: blue

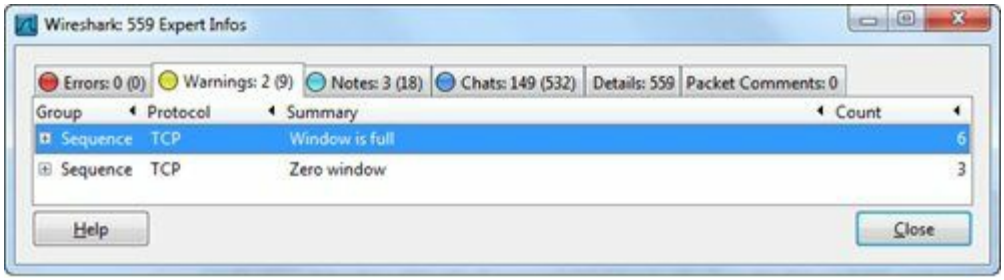
Details: grey

Packet Comments: green

In Figure 106, the **Expert Infos** button is yellow[43], which indicates that there are no Expert errors, but there are warnings in *http-espn101.pcapng*.

*Figure 106. The **Expert Infos** button is color-coded to let you know the highest level of Expert detail seen. [http–espn101.pcapng]*





Deal with "Unreassembled" Indications in the Expert

In Figure 107, we see five different issues listed under the **Warnings** tab. Unfortunately, each item

that begins with "Unreassembled" is listed here because we disabled TCP reassembly (**Edit |**

Preferences | TCP | Allow subdissector to reassemble TCP streams).

Figure 107. If you see these "unreassembled" warnings, consider enabling the Allow subdissector to reassemble TCP streams preference setting. [http–espn101.pcapng]

You can disregard those warnings and continue to examine the other warnings or you can close the

Expert window, enable TCP reassembly, and open the Expert window again, as shown in Figure 108.

Figure 108. The Warnings area indicates that a host has run out of receive buffer space (Zero window). [http–espn101.pcapng]

Filter on TCP Analysis Flag Packets

You can quickly view all packets that are defined as TCP analysis flag packets by simply applying a

display filter for tcp.analysis.flags. If you are only interested in viewing TCP problems in the

trace file, explicitly exclude the Window Update packets by filtering for tcp.analysis.flags

&& !tcp.analysis.window_update. TCP Window Update packets are marked with a TCP

analysis flag, but they are not a problem. They are an indication that a host has just increased its

advertised receive buffer space.

Figure 107 and Figure 108 show the Expert Infos LEDs (visible in eBook only) on the first four

Expert Infos tabs. Consider enabling LEDs in the Expert window to help learn the ***Expert***

Infos *button coloring scheme faster. Select* ***Edit*** **|** ***Preferences*** **|** ***User Interface*** *and enable*

Display LEDs in the Expert Infos dialog tab labels*. Once you make this change, open the*

Expert Infos window to see the color-coded tabs.

5.6. Understand what those Expert Infos

Errors Mean

Wireshark can detect many network problems, but it does not tell you what causes those problems.

Understanding the causes of the errors, warnings, and notes will help you figure out what may be

affecting network performance.

This section lists the most common causes of the various Expert errors, warnings, and notes.

Packet Loss, Recovery, and Faulty Trace Files

Before looking for application problems, check to see if there are TCP errors in the trace file. No

application can perform well when the underlying network is falling apart.

Previous Segment Not Captured (Warnings)

This warning indicates that Wireshark did not see the previous packet(s) in a TCP communication.

Wireshark tracks the packet ordering based on TCP Sequence Numbers and can therefore easily detect

when packets are missing. Packet loss typically occurs at an internetwork device, such as a switch or a

router. Compare the sender's TCP Sequence Number in a packet marked this way to the sender's

previous packet to see how many packets were lost.

ACKed Lost Packet (Warnings)

This warning indicates that Wireshark saw a TCP ACK, but it did not see the data packet that is being

acknowledged. If you were capturing on a spanned switch, the switch may be overloaded and unable to

forward all the packets to Wireshark. A trace file containing numerous ACKed Lost Packet warnings

should not be used for analysis. You do not have a complete view of traffic.

Duplicate ACK (Notes)

These notes indicate that a TCP host receiving data from another host believes a packet is missing.

This is, in essence, a complaint requesting a missing packet. When the sender receives three ACKs

requesting the same data packet (as noted in the Acknowledgment Number field of the ACKs), it

should resend the missing packet. These are part of the packet loss recovery process and are likely

caused by a switch or router dropping packets.

Retransmission (Notes)

These notes occur when Wireshark sees two data packets with the same sequence number. A sender

will retransmit packet when it doesn't receive a timely acknowledgment for a data packet that it sent.

This is another part of the packet loss recovery process (which is most likely caused by a switch or

router dropping packets).

Fast Retransmission (Notes)

These notes occur when Wireshark sees the data packet that someone requested through duplicate

ACKs within 20 ms of that duplicate ACK. This is another part of the packet loss recovery process

(which is also most likely caused by a switch or router dropping packets).

Asynchronous or Multiple Path Indications

Asynchronous paths are indicated when packets travel one path outbound and another path inbound.

Multiple paths are indicated when the individual packets of a datastream can be separated and travel

different routes to the target. This can cause problems if one path is faster than another.

Out-of-Order (Warnings)

This warning indicates that Wireshark saw a packet that has a lower TCP sequence number than a

previous packet. This may indicate that traffic flowed along different paths to reach the target. This

typically is not a problem unless the receiver times out waiting for the out-of-order packet and begins

to complain by sending duplicate ACKs.

Keep-Alive Indication

The TCP keep-alive process is designed to hold an idle TCP connection open for future use. However,

since the connection establishment process doesn't take much time, tearing down the connection when

it is idle relieves both TCP peers of the unnecessary overhead of maintaining the connection.

Keep-Alive (Warnings)

A TCP Keep-Alive packet is sent when a TCP host hasn't received any communication from a peer for

a certain amount of time. If no Keep-Alive ACK is received, the connection may be terminated. The

amount of time that a host waits before generating a Keep-Alive can usually be configured on a TCP

host. This isn't seen as a problem.

Keep-Alive ACK (Notes)

This note is the response to a Keep-Alive packet. It is not seen as a problem.

Receive Buffer Congestion Indications

Each side of a TCP connection maintains a receive buffer (receive window) for incoming data. If an

application is slow taking data out of the buffer, it may fill. When the buffer becomes full, a host

advertises a zero window condition—no more data can be sent to that host on that connection until the

host indicates it has buffer space through a Window Update packet.

Window Full (Notes)

This note indicates that Wireshark has calculated that the packet will fill the available receive buffer

space of the target. This packet itself is not a problem, but it can be the last packet before a zero

window condition.

Zero Window (Warnings)

Zero Window warnings indicate that the sender is advertising a TCP window size value of 0, meaning

it has no receive buffer space available. The other side of the TCP connection cannot send more data if

there is no receive buffer space available. The application running on the host that sent the zero

window packet is not picking up data from the receive buffer. This can be caused by a faulty

application, overloaded host, or even an intentional user prompting process (for example, the prompt

to save a file to a specific location).

Zero Window Probe (Notes)

This note indicates that a host is trying to determine if the target has any receive buffer space

available. In general, this is an optional part of the zero window recovery process.

Zero Window Probe ACK (Notes)

This note indicates a host has responded to a Zero Window Probe. If the window size is still set at zero

then the zero window condition continues.

Window Update (Chats)

This chat detail indicates that the sender is advertising more TCP receive buffer space than in the

previous packet. This is commonly seen in TCP communications and it is the recovery packet seen

after a zero window condition.

TCP Connection Port Reuse Indication

Connection reuse can become a problem if an application simply allows connection timeout at its own

leisure. If the connection is not fully terminated before a host tries to use the port number again, it

should receive a service refusal (TCP Reset).

Reused Ports (Notes)

This note indicates that a host is using the same port number as a previous connection in the trace file.

Some applications may reuse previous ports, but security scanning tools do this as well. The source of

these packets should be investigated.

Possible Router Problem Indication

It seems that as routers become smarter and smarter, they also become dumber. Always test router

configurations and enhancements to see if the router alters the packet in an unacceptable way, such as

the issue listed below.

4 NOPs in a Row (Warnings)

This warning indicates that the TCP option value 0x01, a NOP (No Operation) option, has been seen

four times in a row in a packet. Since these NOPs are used to pad a TCP header to end on a 4-byte

boundary, you should never see four in a row. This is typically caused by a misbehaving router along

the path.

Misconfiguration or ARP Poisoning Indication

This is an expert indication that must be investigated further to determine if you are facing an

intentional or unintentional problem.

Duplicate IP Address Configured (Warnings)

This warning indicates that two or more ARP (Address Resolution Protocol) response packets offer

different hardware addresses for the same IP address. This is very unusual and can either indicate that

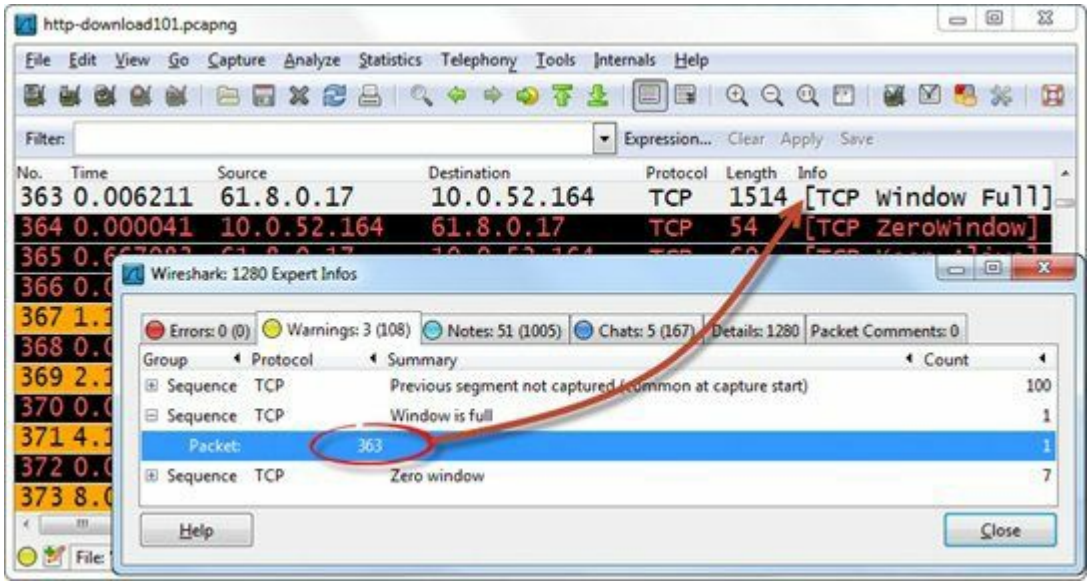
a host IP address was configured incorrectly (a static address that conflicts with the same address as a

dynamically-assigned address) or a system is ARP poisoning the network.

When troubleshooting network communications, always open the Expert Infos window to identify any

warnings or notes. Look for any problems related to TCP before pointing at an application as the cause

of poor performance.


http-download101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
363 0.006211 61.8.0.17 10.0.52.164 TCP 1514 [TCP Window Full]
364 0.000041 10.0.52.164 61.8.0.17 TCP 54 [TCP ZeroWindow]
Wireshark: 1280 Expert Infos
Errors: 0 (0)
Warnings: 3 (108)
Notes: 51 (1005)
Chats: 5 (167)
Details: 1280
Packet Comments: 0
Group Protocol Summary Count
Sequence TCP Previous segment not captured (common at capture start) 100
Sequence TCP Window is full 1
Packet: 363 1
Sequence TCP Zero window 7
Help
Close

Lab 35: Identify an Overloaded Client

In this lab we use the Expert Infos window to identify the cause of poor network performance. Not

only is the client overloaded in this trace file, but there is packet loss along the path as well.

Step 1: Open ***http-download101.pcapng***.

Step 2: Click the **Expert Infos** button on the Status Bar.

Step 3: Click the **Errors**, **Warnings**, and **Notes** tabs to examine the problems in this trace file.

Step 4: In the **Warnings** tab, expand the **Window is Full** and **Zero Window** sections. Click on the line listing **packet 363**. Wireshark jumps to that packet in the trace file. This is where Wireshark

indicates that the client is going to run out of receive buffer space.

If you look past the window zero problem in this trace file, you can see the client recover with a

Window Update packet. A quick glance at the **Time** column (set to *Seconds Since Previous Displayed*

Packet) and you'll understand why this is a condition to watch for on your network.

Step 5: [Lab Clean-up] When you are finished looking through the Expert information, click the **Close**

button in the Expert Infos window.

The Expert Infos window is one of the first places you should look when analyzing network

performance issues.

5.7. Graph Various Network Errors

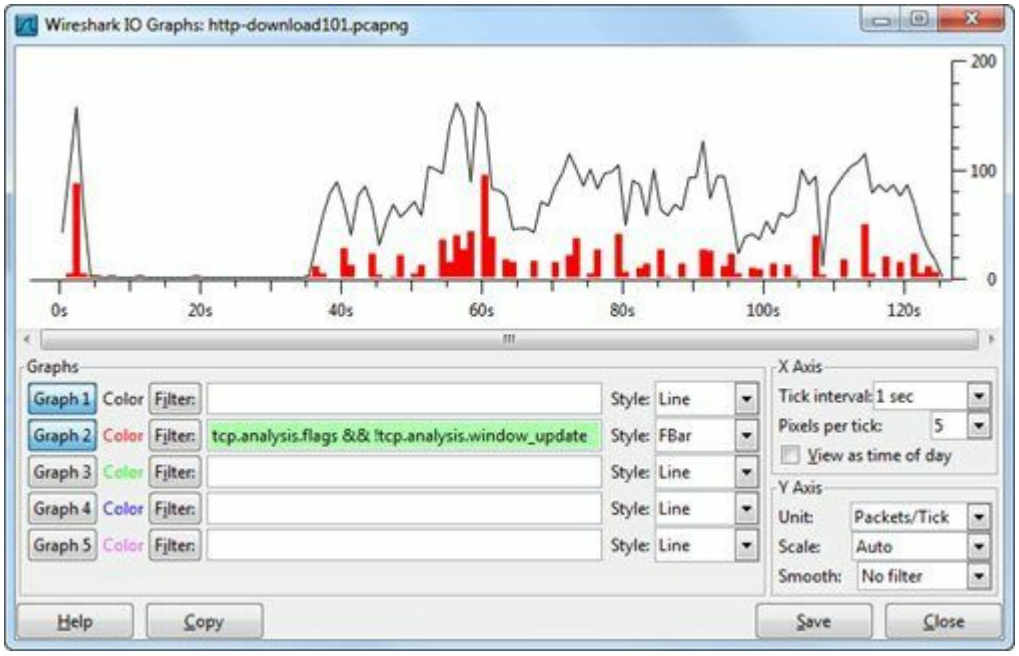
Wireshark understands many types of TCP network errors, such as packet loss and receiver

congestion. When Wireshark sees packets that indicate network problems have occurred, it tags the

packets with "tcp.analysis.flags."

Just as you applied IP address and port filters in the previous tasks, you can also graph all TCP

analysis flags or specific flags.



Graph all TCP Analysis Flag Packets (Except Window Updates)

If you are going to graph all the TCP errors, you will need to exclude one type of tagged packet that

was tagged incorrectly. A window update packet is good. It indicates a host has more buffer space

available to receive data. Wireshark tags these packets with the tcp.analysis.flags setting.

Most other items flagged this way indicate that there are TCP problems so we must explicitly exclude

the window update packets when graphing TCP problems.

In Figure 109, we opened *http-download101.pcapng* and graphed TCP problems using Fbar format on

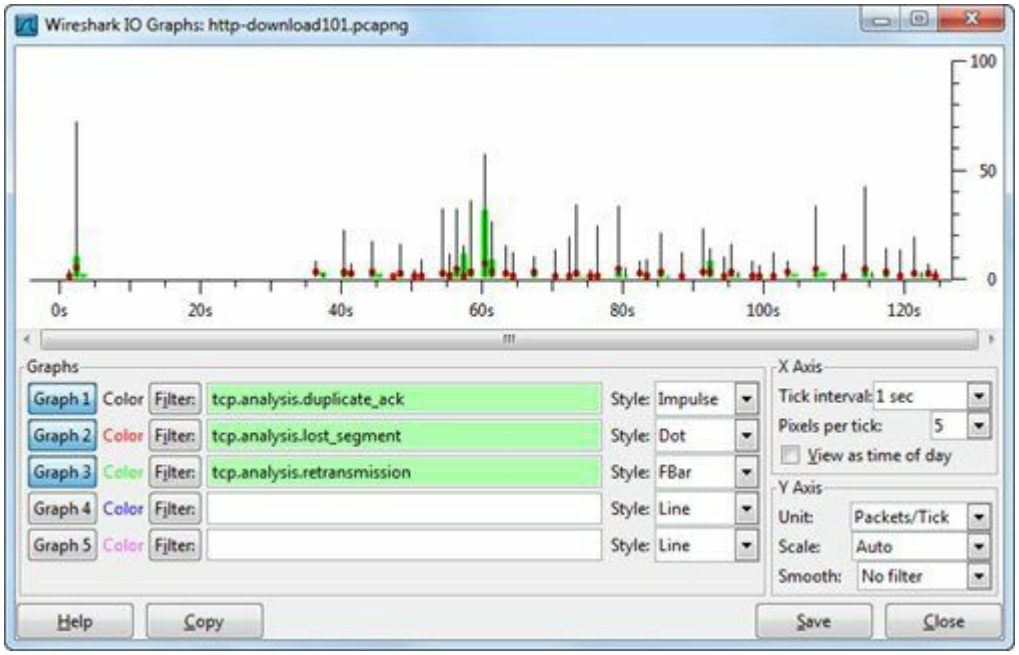
Graph 2. We explicitly excluded the window update packets in our filter (tcp.analysis.flags

&& !tcp.analysis.window_update). We needed to widen the IO Graph to view the entire

filter area. All traffic is still shown by the Graph 1 line.

Figure 109. We graphed all the tcp.analysis.flags packets while excluding the window update packets. [http-

download101.pcapng]



TIP

Graph Separate Types of TCP Analysis Flag Packets

In Figure 110, we graphed separate TCP problems to show the relationship between them. Lost

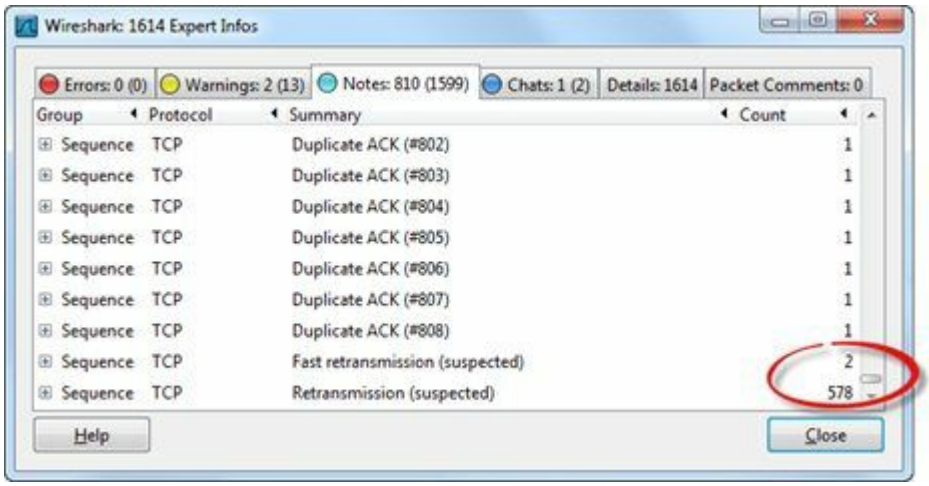
segments lead to duplicate ACKs which lead to retransmissions.

Figure 110. You can plot the separate TCP problems to observe the relationship between them. [http–download101.pcapng]

A picture really is worth a thousand words. By graphing the TCP analysis flag packets

alongside the general flow of traffic, you can see the relationship between TCP problems and

drops in throughput.



Lab 36: Detect and Graph File Transfer Problems

In this lab we examine a file transfer process that takes place over TCP. Before we can consider

troubleshooting the application itself, we must rule out TCP problems.

Step 1: Open ***general101d.pcapng***.

Step 2: Click the **Expert Infos** button on the Status Bar.

Step 3: Click the **Errors**, **Warnings**, and **Notes** tabs to see which problems were identified by Wireshark in the trace file.

Wireshark indicates that there is significant packet loss in this trace file.

Notice that we see 578 retransmissions, but only 2 fast retransmissions. This is an indication that the

host sending the data packets has noticed packet loss (ACKs did not arrive in a timely manner).

In addition, we can see that Duplicate ACKs reached up to 808 which is an amazingly high number.

This is a sure sign that we have some major problems along the path.

Step 4: Close the Expert Infos window and select **Statistics | IO Graph**.

Step 5: Enter tcp.analysis.flags && !tcp.analysis.window_update in the Graph 2

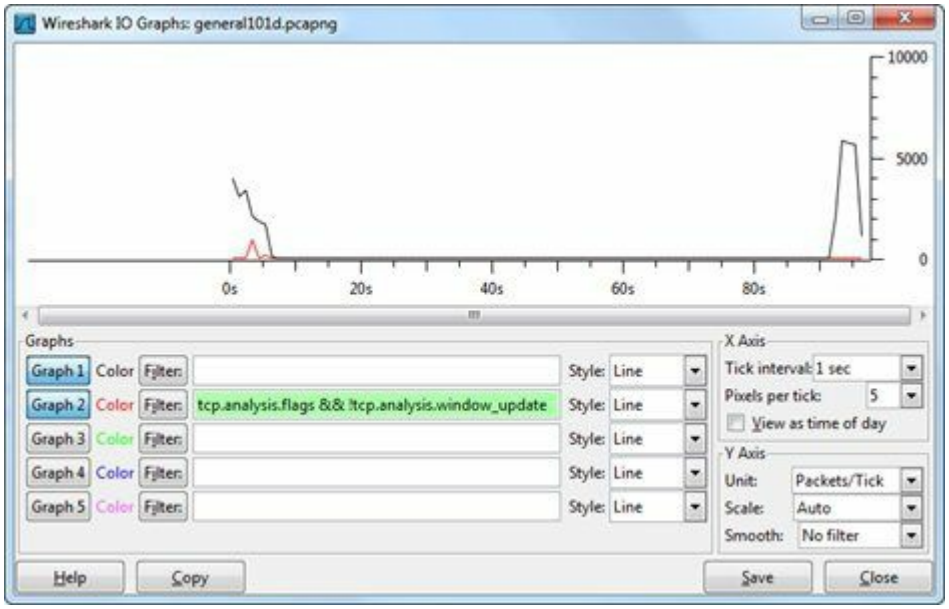
filter area and click the **Graph 2** button.

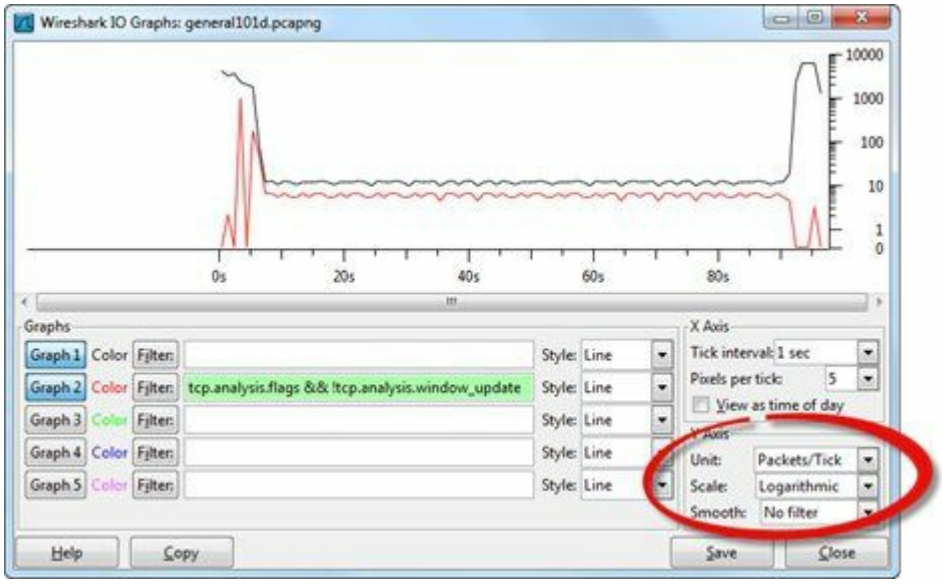
The graph isn't very impressive at this point because we are graphing two very disparate values—the

packets per second vs. these specific analysis flag packets.

One of the problems you will face over and over is the problem of graphing two very different values.

When you encounter this issue, change the Y axis scale to logarithmic.





Step 6: Click the arrow next to the Y axis scale area and set the scale to **Logarithmic**. This should completely change the look of your graph.

We can now see that our Graph 2 line spiked just before the drop in throughput. We can also see from

the relatively flat graph lines, between the spikes, that there were both analysis flagged packets and

various other packets. When you click on any plotted point in the graph, Wireshark jumps to that spot

in the trace file, allowing you to examine the situation further.

Step 5: [Lab Clean-up] Click the **Close** button when you are finished viewing the IO Graph.

You can build a graph on any display filter value. When performance problems arise, graphing TCP

problems alongside all traffic enables you to find out if the TCP problems are related to throughput

drops.

Chapter 5 Challenge

Open *challenge101-5.pcapng* and use the techniques covered in this chapter to answer these Challenge

questions. The answer key is located in Appendix A.

Question 5-1.

Create an IO Graph for this trace file. What is the highest packets-per-second value seen in this trace

file?

Question 5-2.

What is the highest bits-per-second value seen in this trace file?

Question 5-3.

How many TCP conversations are in this trace file?

Question 5-4.

How many times has " *Previous segment not captured*" been detected in this trace file?

Question 5-5.

How many retransmissions and fast retransmissions are seen in this trace file?

Chapter 6 Skills: Reassemble Traffic for

Faster Analysis

"Network analysis is all about the packets: what kind of story are the packets telling? Even if you

speak fluent binary, you need a tool that will quickly break down the packets and the protocols/packet

structure. If your login fails, what really failed? The packets will tell you. What if you are using

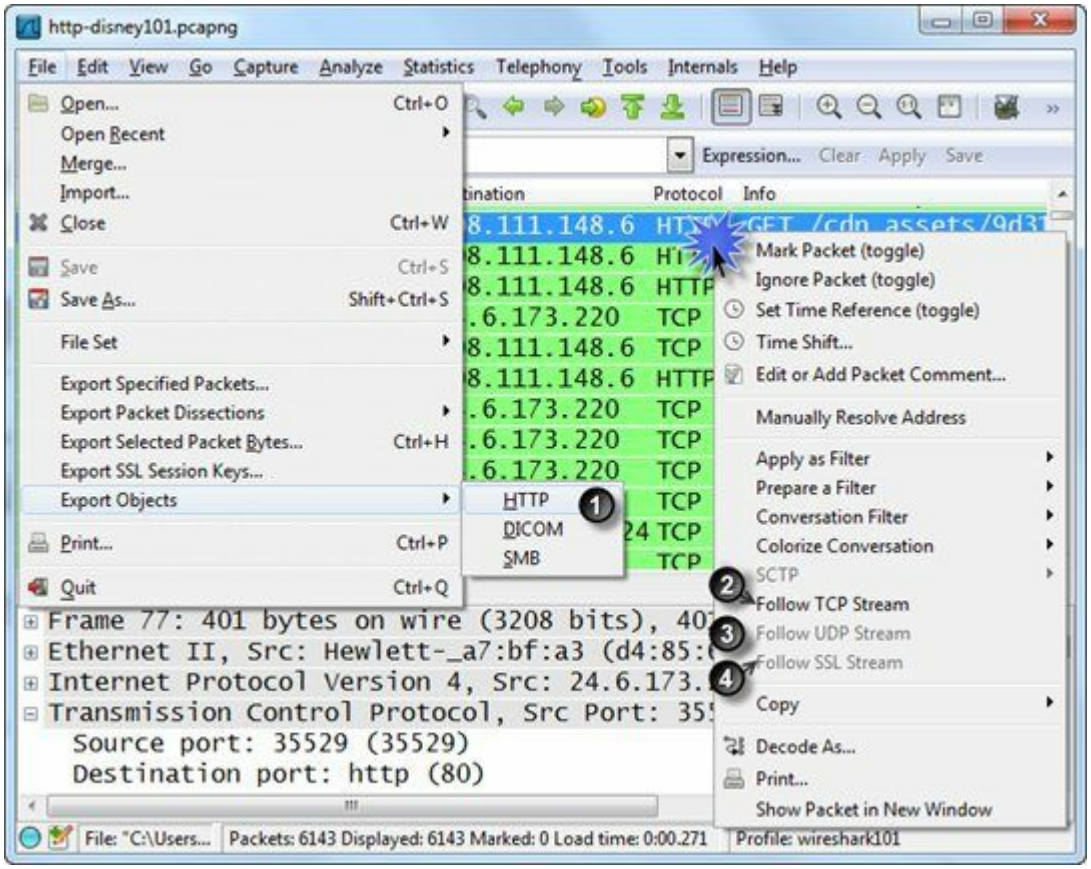
LANDesk to capture an image and it gets so far, looking successful, then just dies. No errors. Nothing.

The packets tell the story (your imaging AD account password expired...who knew?) Look at the

packets first instead of when all else fails."

Lanell Allen

Wireshark Certified Network Analyst™



Quick Reference: File and Object Reassembly Options

1. Select **File | Export Objects | [HTTP|DICOM|SMB]** to reassemble objects[44]

2. Right-click in the Packet List pane and select **Follow TCP Stream**[45]

(TCP stream filter)

3. Right-click in the Packet List pane and select **Follow UDP Stream**

(UDP port numbers and IP addresses filter)

4. Right-click in the Packet List pane and select **Follow SSL Stream**

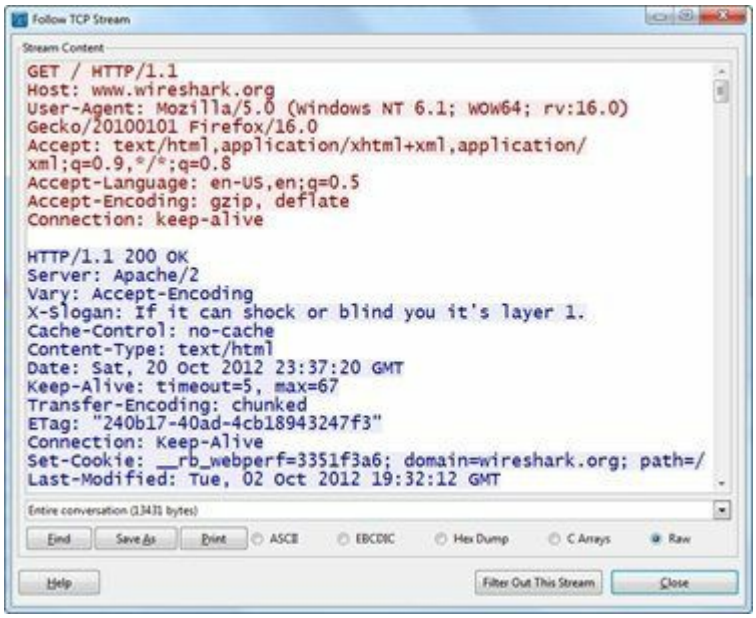
(SSL port number and IP addresses filter)

6.1. Reassemble Web Browsing Sessions

Whether you are troubleshooting a slow web browsing session or you just want to look "under the

hood" of an HTTP communication, you can use Wireshark's reassembly feature to see what's really

going on by rebuilding the conversations between HTTP clients and servers.



Use Follow TCP Stream

Right-click on an HTTP packet in the Packet List pane and select **Follow TCP Stream**. Wireshark

rebuilds the conversation without any MAC-layer, IPv4/IPv6, UDP/TCP headers or field names. The

result is a clearer picture of what is being said between hosts. In Figure 111, we opened *http–*

browse101.pcapng, right-clicked on packet 10 (an HTTP GET request) in the Packet List pane, and

selected **Follow TCP Stream**. The conversation is color-coded: red for the first host seen in the

conversation and blue for the second host seen in the conversation[46].

Figure 111. The communications become much clearer when you follow the stream. [http–browse101.pcapng]

If you look at the display filter area, you'll note that Wireshark applies a filter based on the TCP

Stream index (tcp.stream eq 0). This is a unique number given to each TCP conversation. This is the

first TCP stream in the file, and is given Stream index number 0.

TCP stream numbers are assigned by Wireshark. This field does not exist in the actual packet.

Use Find, Save, and Filter on a Stream

There are several options available after you follow a stream.

Click **Find** to search for a text string.

Click **Save As** to save the conversation as a separate file. The Save As feature is great if you want

to export a file that was transported across a conversation.

Select **Filter Out This Stream** to create and apply an exclude display filter for this stream

(!tcp.stream eq 0). The ability to filter out conversations after examining them is crucial in

narrowing down suspicious traffic on a network.

You will use the **Filter Out This Stream** function in Lab 38.

```
X-Slogan: Sniffing the glue that holds the Internet together.
```

Lab 37: Use Reassembly to Find a Web Site's Hidden HTTP Message

It is not unusual to have numerous "hidden" messages sent to your browser when you hit a web site. In

this lab you will analyze a trace file that contains two hidden messages. Afterwards, visit the same

web site again to catch other interesting messages.

Step 1: Open ***http-wiresharkdownload101.pcapng***.

Check your TCP preference setting to ensure ***Allow subdissector to reassemble TCP streams*** is

enabled. This setting is required for proper HTTP reassembly.

Step 2: The first three packets are the TCP handshake for the web server connection. Frame 4 is the

client's GET request for the *download.html* page. Right-click on frame 4 and select **Follow TCP**

stream.

Traffic from the first host seen in the trace file, the client in this case, is colored red. Traffic from the

second host seen in the trace file, the server in this case, will be colored blue.

Step 3: Wireshark displays the conversation without the Ethernet, IP, or TCP headers. Scroll through

the stream to look for the hidden message from Gerald Combs, creator of Wireshark. It is located in

the server stream and begins with *X-Slogan*.

Step 4: This isn't the only message hidden in the web browsing session. Now that you know the

message begins with "X-Slogan," how could you have Wireshark display every frame that has this

ASCII string? Click the **Close** button and then the **Clear** button to remove the TCP stream filter.

Apply the display filter frame contains "X-Slogan".

Step 5: Right-click on the two other displayed frames and select **Follow TCP Stream** to examine the

HTTP headers exchanged between hosts. Did you find the other message? Note that you can only

follow one stream at a time using this right-click method. You will need to clear out your display

filter before following the next stream.

Step 6: Try this one on your own. Capture all traffic to and from your machine and browse to

www.wireshark.org several times. This slogan value changes frequently to send a set of interesting

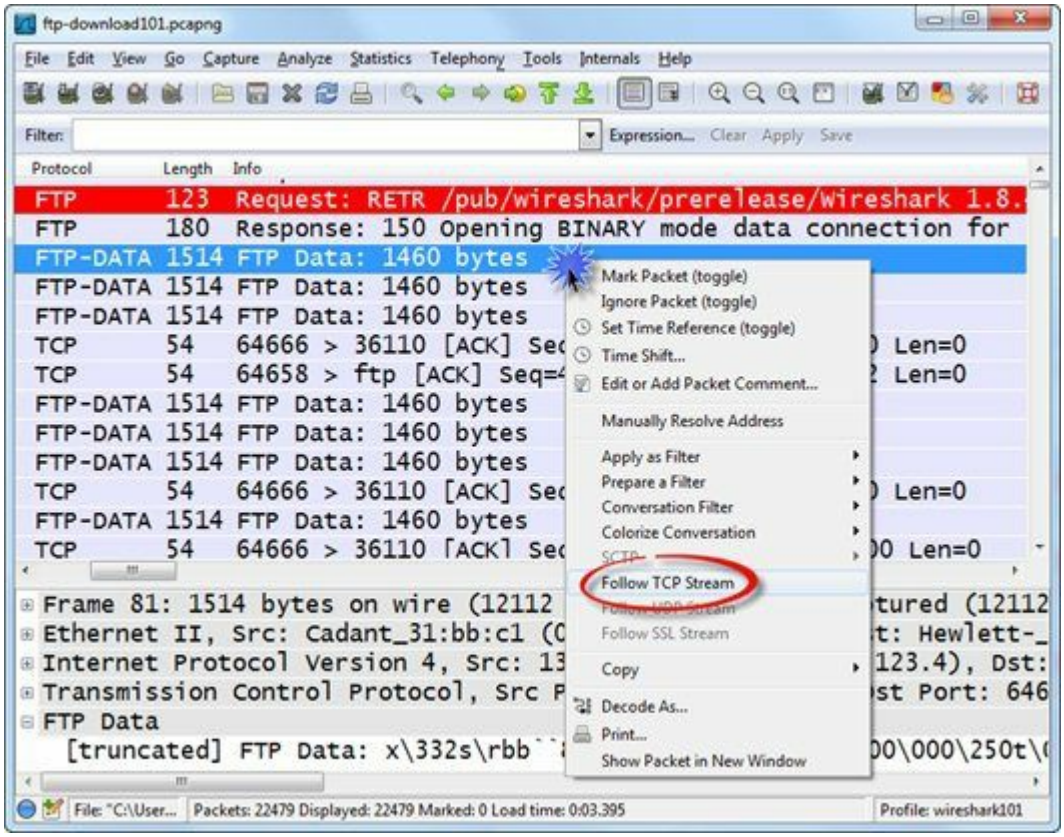
messages.

Step 7: [Lab Clean-up] Click the **Close** button on the Follow TCP Stream window when you have

finished following streams.

Rather than scroll through a trace file and examine each packet one at a time, follow the TCP, UDP, or

SSL streams[47]. This is a function you will use again and again in your analysis process.


ftp-download101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
Protocol Length Info
FTP 123 Request: RETR /pub/wireshark/prerelease/Wireshark 1.8.
FTP 180 Response: 150 Opening BINARY mode data connection for
FTP-DATA 1514 FTP Data: 1460 bytes
FTP-DATA 1514 FTP Data: 1460 bytes
FTP-DATA 1514 FTP Data: 1460 bytes
TCP 54 64666 > 36110 [ACK] Se
TCP 54 64658 > ftp [ACK] Seq=4
FTP-DATA 1514 FTP Data: 1460 bytes
FTP-DATA 1514 FTP Data: 1460 bytes
FTP-DATA 1514 FTP Data: 1460 bytes
TCP 54 64666 > 36110 [ACK] Se
FTP-DATA 1514 FTP Data: 1460 bytes
TCP 54 64666 > 36110 [ACK] Se
Len=0
Len=0
Len=0
Len=0
Mark Packet (toggle)
Ignore Packet (toggle)
Set Time Reference (toggle)
Time Shift...
Edit or Add Packet Comment...
Manually Resolve Address
Apply as Filter
Prepare a Filter
Conversation Filter
Colorize Conversation
SCTP
Follow TCP Stream
Follow UDP Stream
Follow SSL Stream
Copy
Decode As...
Print...
Show Packet in New Window
Frame 81: 1514 bytes on wire (12112
Ethernet II, Src: Cadant_31:bb:c1 (C
Internet Protocol Version 4, Src: 13
Transmission Control Protocol, Src P
FTP Data
[truncated] FTP Data: x\332s\rbb
tured (12112
t: Hewlett-_
123.4), Dst:
st Port: 646
00\000\250t\
File: "C:\User... Packets: 22479 Displayed: 22479 Marked: 0 Load time: 0:03.395
Profile: wireshark101

TIP

6.2. Reassemble a File Transferred via FTP

Wireshark's ability to reassemble files transferred on a network might surprise some people. It should

also emphasize the importance of using a secure channel or even file encryption to protect against

unwanted interception and reassembly of confidential files.

FTP communications use two types of connections: a command channel and a data channel. The data

channel only consists of the TCP handshake to establish the connection and then the actual data

transfer itself. Using Follow TCP Stream on the data channel, you can easily reassemble the

transferred file into its original format.

Locate the data channel by either watching packets in the command channel leading up to it, locating

"FTP-DATA" in the **Protocol** column, or looking for maximum-sized packets following the RETR or

STOR command. Sometimes the FTP data channel will be established over the default port 20, but

that's not required. In the command channel communications, another port number can be defined for

the data channel.

To reassemble the file transferred on the FTP data channel, right-click on the data packet and select

Follow TCP Stream, as shown in Figure 112.

Figure 112. Look for the FTP-DATA or full-sized packets after the RETR or STOR command. [ftp–download101.pcapng]

Wireshark displays the communications in raw format, indicating the direction of the data flows using

color coding (red is applied to the first communicating host while blue is applied to the second

communicating host). Select **Save As** and name your new file based on the file name seen in the RETR

or STOR command preceding this file transfer.

That's it. You now have an exact duplicate of the file that was transferred over FTP.

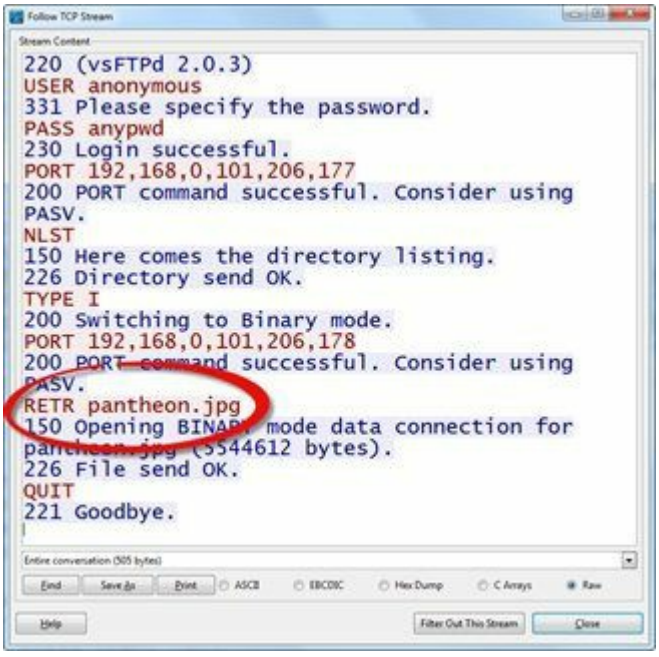
When you follow streams that contain a file, you can usually identify the file based on the first

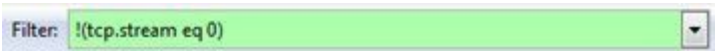
few bytes. For example, .jpg image files begin with JFIF whereas .png image files begin with

the byte string 0x89-50-4E-47. It's good to know what format the file uses if you want to

reassemble that file. Take a look at a tool called TRIDnet to identify file types (mark0.net/soft-

tridnet-e.html).





Lab 38: Extract a File from an FTP File Transfer

In this lab you will follow an FTP data stream to reassemble the file that was transferred. First you

will reassemble the command channel traffic to see the client login and file retrieval commands, and

then you will reassemble the data transfer channel traffic to view the file transferred.

Step 1: Open ***ftp-clientside101.pcapng***.

Step 2: Scroll through the beginning of this trace file. You will see numerous FTP commands used to

login, request a directory, define a port number for the data transfer, and retrieve a file.

Step 3: Right-click on **frame 6** (USER anonymous) and select **Follow TCP Stream**. You can easily read the commands and responses exchanged between the client and server. The client logged in

(USER and PASS), requested the directory listing (NLST), set the transfer type to binary (TYPE),

defined a port to use for the data channel (PORT), requested a file (RETR), and ended the connection

(QUIT).

Step 4: There are two data connections in this trace file: one for the directory list and another for the file transfer. We are only interested in these two data streams, and not the command channel stream.

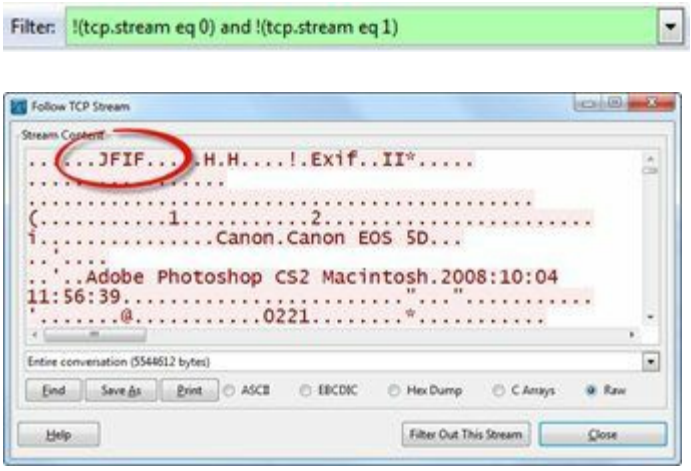
In the Follow TCP Stream window, click the **Filter Out This Stream** button. This closes the TCP

stream window and applies an exclusion filter.

Step 5: Now you only see the data channel traffic. Frames 16 through 18 and frames 35 through 38 are

TCP handshake packets to establish the two required data channels.

Right-click on **frame 16** and select **Follow TCP Stream**. This stream list indicates there is only one file (*pantheon.jpg*) in the directory. Remember this file name. You will use it later in this lab.



Step 6: Click the **Filter Out This Stream** button. This closes the TCP stream window and adds to the existing exclusion filter.

Step 7: The only remaining traffic displayed is the file transfer traffic. Right-click on any frame and

select **Follow TCP Stream**.

You can view the file identifier that indicates this is a .jpg file (JFIF) and the metadata contained in

the graphic file.

Step 8: To reassemble the graphic image transferred in this FTP communication, click the **Save As**

button, select a target directory for the file, and set the file name as *pantheon.jpg*. Click **Save**.

Step 9: Navigate to the target directory and open ***pantheon.jpg***. You should see the following photo.

Step 7: [Lab Clean-up] When you've finished examining the Pantheon image you extracted, close your

image viewer. Return to Wireshark to close the TCP Stream window and clear your display filter.

It is easy to reassemble files transferred by FTP. Use **Follow TCP Stream** and **Filter Out This**

Stream to examine the commands and filter them out of view.

6.3. Export HTTP Objects Transferred in a

Web Browsing Session

When analyzing HTTP communications, it can be helpful to see what individual page elements (HTTP

objects) were transferred. You can reassemble html, graphics, JavaScript, videos, style sheet objects,

and more.

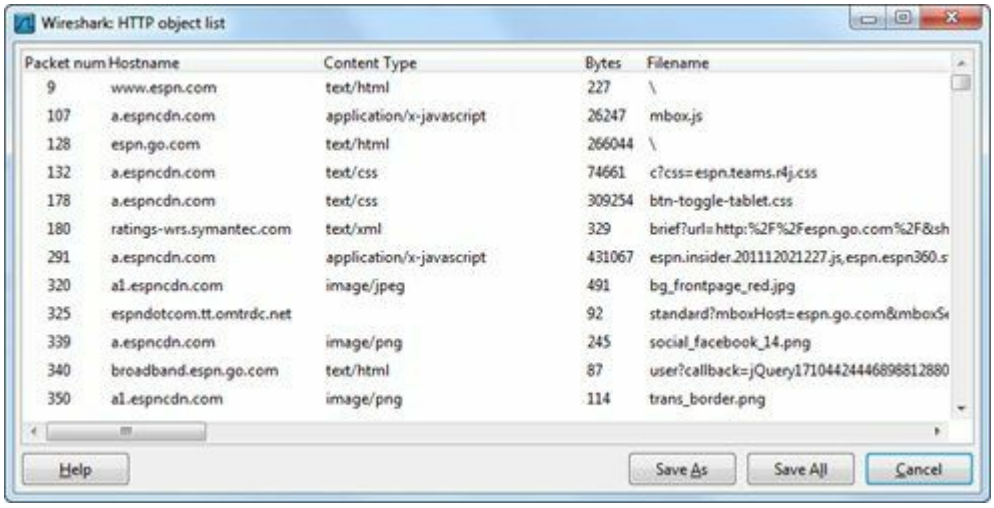
Check Your TCP Preference Settings First!

Before beginning this process, ensure your TCP preference for *Allow subdissector to reassemble TCP*

streams is enabled.

If you don't enable TCP reassembly, Wireshark cannot reassemble the HTTP objects. In fact,

Wireshark will list each packet used to transfer an object rather than each object.


Wireshark: HTTP object list
Packet num Hostname Content Type Bytes Filename
9 www.espn.com text/html 227 \
107 a.espncdn.com application/x-javascript 26247 mbox.js
128 espn.go.com text/html 266044 \
132 a.espncdn.com text/css 74661 c?css=espn.teams.r4j.css
178 a.espncdn.com text/css 309254 btn-toggle-tablet.css
180 ratings-wrs.symantec.com text/xml 329 brief?url=http:%2F%2Fespn.go.com%2F&sh
291 a.espncdn.com application/x-javascript 431067 espn.insider.201112021227.js,espn.espn360.s
320 a1.espncdn.com image/jpeg 491 bg_frontpage_red.jpg
325 espndotcom.tt.omtrdc.net 92 standard?mboxHost=espn.go.com&mboxS
339 a.espncdn.com image/png 245 social_facebook_14.png
340 broadband.espn.go.com text/html 87 user?callback=jQuery171044244468968128 80
350 a1.espncdn.com image/png 114 trans_border.png
Help
Save As
Save All
Cancel

TIP

View all HTTP Objects in the Trace File

After capturing HTTP traffic or opening an HTTP trace file, select **File | Export Objects | HTTP**.

Wireshark displays all the elements transferred in the HTTP traffic.

In Figure 113, we opened *http-espn101.pcapng* and selected **File | Export Objects | HTTP** to list the various objects transferred when someone browsed to *www.espn.com*. Note that the client connected to

numerous servers when building the main view of the web site. Some of these objects were served by

ad servers.

*Figure 113. Select **File | Export Objects | HTTP** to export one or all of the objects. [http–espn101.pcapng]*

The HTTP object list window lists all the files transferred in the trace file.

The **Packet num** column indicates the first packet in each file transfer process.

The **Hostname** column provides the *http.host* value from the GET request that preceded each

file transfer.

The **Content Type** column indicates the format of the objects. The objects may be graphics (.png,

.jpg, or .gif, for example), scripts (.js, for example), or even videos (.swf or .flv, for example).

The **Bytes** column indicates the size of the transferred object.

The **Filename** column provides the name of the object requested. The request for "\" indicates a

request for the default element (such as *index.html*) on a web page.

To export all the objects, select **Save All** and be patient. This may take a long time if lots of HTTP

objects are listed.

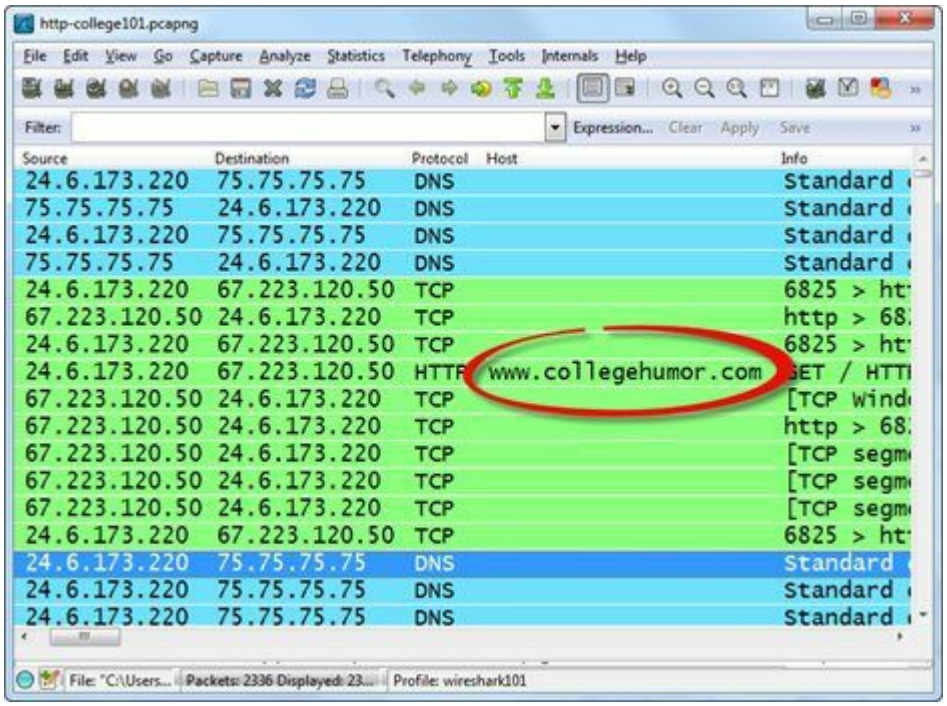
To export a single object, select the object and click **Save As**. Wireshark will fill out the file name

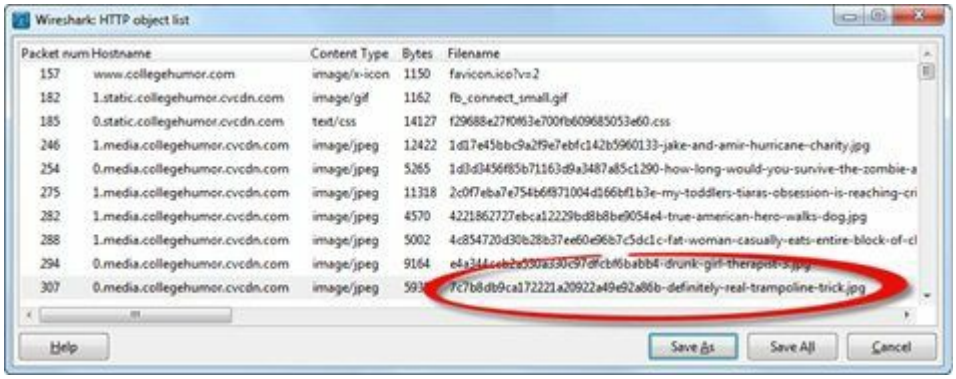
based on the object name, so all you need to do is select an export directory.

If you don't recognize some of the file extensions shown in the HTTP Object List window

(such as .css for Cascading Style Sheets), visit www.fileinfo.com/help/file_extension. You can enter the file extension in the search box to look up the file type and a list of programs that

use that type of file.


http-college101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
Source Destination Protocol Host Info
24.6.173.220 75.75.75.75 DNS Standard
75.75.75.75 24.6.173.220 DNS Standard
24.6.173.220 75.75.75.75 DNS Standard
75.75.75.75 24.6.173.220 DNS Standard
24.6.173.220 67.223.120.50 TCP 6825 > ht
67.223.120.50 24.6.173.220 TCP http > 68
24.6.173.220 67.223.120.50 TCP 6825 > ht
24.6.173.220 67.223.120.50 HTTP www.collegehumor.com GET / HTT
67.223.120.50 24.6.173.220 TCP [TCP Wind
67.223.120.50 24.6.173.220 TCP http > 68
67.223.120.50 24.6.173.220 TCP [TCP segm
67.223.120.50 24.6.173.220 TCP [TCP segm
67.223.120.50 24.6.173.220 TCP [TCP segm
24.6.173.220 67.223.120.50 TCP 6825 > ht
24.6.173.220 75.75.75.75 DNS Standard
24.6.173.220 75.75.75.75 DNS Standard
24.6.173.220 75.75.75.75 DNS Standard
File: "C:\Users... Packets: 2336 Displayed: 23... Profile: wireshark101


Wireshark: HTTP object list
Packet num Hostname Content Type Bytes Filename
157 www.collegehumor.com image/x-icon 1150 favicon.ico?v=2
182 1.static.collegehumor.cvcdn.com image/gif 1162 fb_connect_small.gif
185 0.static.collegehumor.cvcdn.com text/css 14127 f29688e27f0f63e700fb609685053e60.css
246 1.media.collegehumor.cvcdn.com image/jpeg 12422 1d17e45bbc9a2f9e7ebfc142b5960133-jake-and-amir-hurricane-charity.jpg
254 0.media.collegehumor.cvcdn.com image/jpeg 5265 1d3d3456f85b71163d9a3487a85c1290-how-long-would-you-survive-the-zombie-a
275 1.media.collegehumor.cvcdn.com image/jpeg 11318 2c0f7eba7e754b6f871004d166bf1b3e-my-toddlers-tiaras-obsession-is-reaching-cri
282 1.media.collegehumor.cvcdn.com image/jpeg 4570 4221862727ebca12229bd8b8be9054e4-true-american-hero-walks-dog.jpg
288 1.media.collegehumor.cvcdn.com image/jpeg 5002 4c854720d30b28b37ee60e96b7c5dc1c-fat-woman-casually-eats-entire-block-of-cl
294 0.media.collegehumor.cvcdn.com image/jpeg 9164 e4a344ceb2a030a330c97dfcbf6babb4-drunk-girl-therapist-a.jpg
307 0.media.collegehumor.cvcdn.com image/jpeg 593 7c7b8db9ca172221a20922a49e92a86b-definitely-real-trampoline-trick.jpg
Help
Save As
Save All
Cancel

Lab 39: Carve Out an HTTP Object from a Web Browsing

Session

In this lab, you will open a trace file that contains a web browsing session. Using the **File | Export**

Objects process, you will extract one of the images transferred during the web browsing session.

Step 1: Open ***http-college101.pcapng***.

Step 2: If you didn't already do so while reading the previous section, enable your *Allow subdissector to reassemble TCP streams* setting (**Edit | Preferences | (+) Protocols | TCP**). When you finish this lab you will disable the setting again. This setting is required for the **File | Export Objects** function.

Step 3: You created a **Host** column in Lab 15[48]. It may be hidden, however. Right-click any column heading and select **Displayed Columns | Host (http.host)**. You may need to widen your **Host** column

to see full host names.

When you scroll through the trace file, you can see the user is browsing *collegehumor.com*. We will

create a list of the HTTP objects transferred in this trace file and then extract one of the files.

In Lab 38, you used **Follow TCP Stream** to extract a file from an FTP data transfer process. It's much

easier to extract HTTP objects.

Step 4: Select **File | Export Objects | HTTP**. Scroll through the list of objects to find a file called *7c7b8db9ca172221a20922a49e92a86b-definitely-real-trampoline-trick.jpg* that begins downloading

in frame 307.

Step 5: Click **Save As**, select the target directory and let Wireshark use the actual file name. Click **Save**.

Navigate to your target directory to view the saved file.

Step 6: [Lab Clean-up] Close the HTTP Object List window and right-click on a TCP header in the

Packet List pane and disable the ***Allow subdissector to reassemble TCP streams*** setting.

Wireshark's object exporting capability does a good job carving HTTP objects out of a web browsing

session. It does *not* do a good job helping you look through the exported files, however. You must use

an external viewer to see the files.

If you are a forensic investigator who needs to export thousands of files from traffic (also referred to

as "data carving"), check out *Network Miner*, a free network forensic tool that can import .pcap[49]

files and carve out and display the images. You can download Network Miner from

www.netresec.com.

Chapter 6 Challenge

Open *challenge101-6.pcapng* and use the techniques covered in this chapter to answer these Challenge

questions. The answer key is located inAppendix A.

Question 6-1.

What two .jpg files can be exported from this trace file?

Question 6-2.

On what HTTP server and in what directory does *next-active.png* reside?

Question 6-3.

Export *booksmall.png* from this trace file. What is in the image?

Question 6-4.

Reassemble TCP stream 7. What type of browser is the client using in this stream?

Chapter 7 Skills: Add Comments to Your

Trace Files and Packets

"Wireshark is like an X-ray machine. It gives you a look at what's going on inside (the network), but

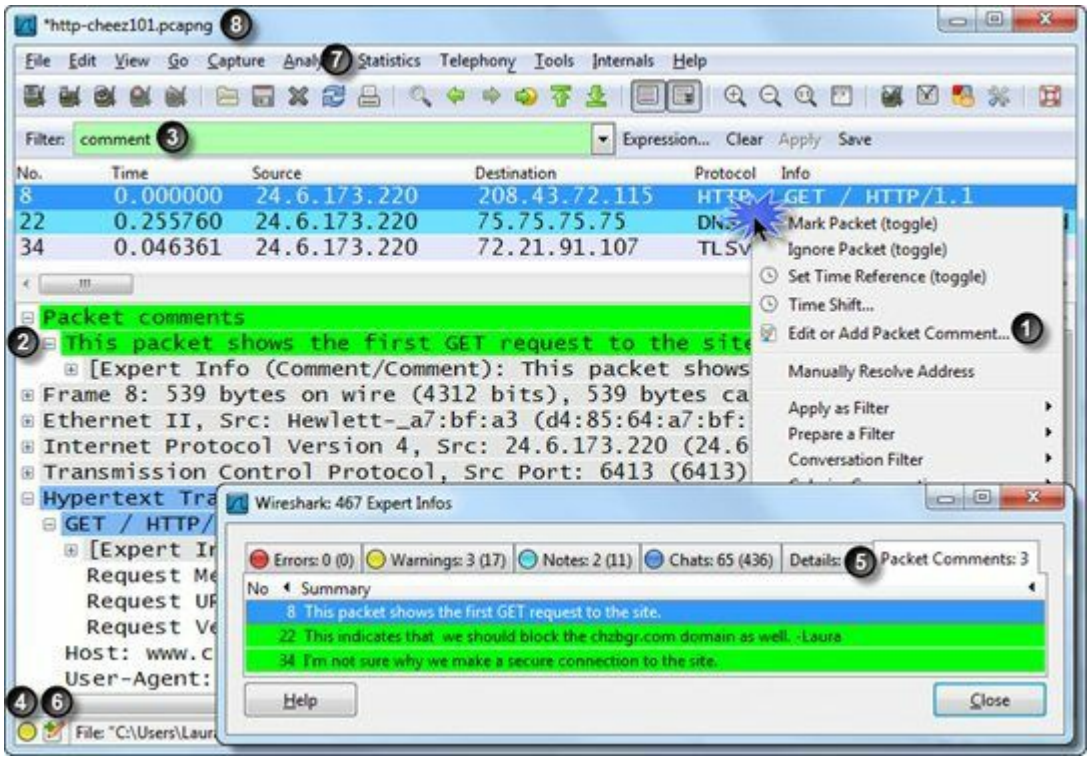
you need to develop the skills to interpret what you see and know what to look for—practice makes

perfect."

Anders Broman

Wireshark Core Developer

and System Tester, Ericsson


*http-cheez101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: comment
Expression... Clear Apply Save
No. Time Source Destination Protocol Info
8 0.000000 24.6.173.220 208.43.72.115 HTTP GET / HTTP/1.1
22 0.255760 24.6.173.220 75.75.75.75 DNS
34 0.046361 24.6.173.220 72.21.91.107 TLSV
Mark Packet (toggle)
Ignore Packet (toggle)
Set Time Reference (toggle)
Time Shift...
Edit or Add Packet Comment...
Manually Resolve Address
Apply as Filter
Prepare a Filter
Conversation Filter
Packet comments
This packet shows the first GET request to the site
[Expert Info (Comment/Comment): This packet shows
Frame 8: 539 bytes on wire (4312 bits), 539 bytes ca
Ethernet II, Src: Hewlett-_a7:bf:a3 (d4:85:64:a7:bf:
Internet Protocol Version 4, Src: 24.6.173.220 (24.6
Transmission Control Protocol, Src Port: 6413 (6413)
Hypertext Tra
GET / HTTP/
[Expert In
Request Me
Request UR
Request Ve
Host: www.c
User-Agent:
Wireshark: 467 Expert Infos
Errors: 0 (0) Warnings: 3 (17) Notes: 2 (11) Chats: 65 (436) Details: Packet Comments: 3
No Summary
8 This packet shows the first GET request to the site.
22 This indicates that we should block the chzbgr.com domain as well. -Laura
34 I'm not sure why we make a secure connection to the site.
Help
Close
File: "C:\Users\Laur

Quick Reference: File and Packet Annotation Options

1. **Edit or Add Packet Comment**—Right-click on a packet to create/edit a packet comment

2. **Packet comments section**—Packet comments are displayed in front of the Frame section

3. comment**filter**—Apply a filter for comment to view all packets that contain comments

4. **Expert Infos button**—Click to open the Expert Infos window which contains the Packet

Comments tab

5. **Expert Infos window/Packet Comments tab**—Click once on a comment to jump to the

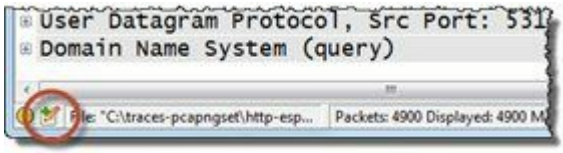
comment; click twice to open and edit a comment

6. **Trace File Annotation button**—Click to open or edit the trace file annotation window[50]

7. **Statistics | Summary**—Displays trace file information, including trace file annotations

8. **Title bar**—Wireshark adds an asterisk to the Title Bar to indicate that changes to the trace file

(such as trace file or packet annotations) have not been saved


User Datagram Protocol, Src Port: 531
Domain Name System (query)
File: "C:\traces-pcapngset\http-esp...
Packets: 4900 Displayed: 4900 M

Edit or Add Capture Comments
From Laura - Beverly complained about this web browsing session. I didn't see packet loss, but I did see connections to some suspicious servers. Look through this and let me know what you think. Thanks!
Help
OK
Cancel

7.1. Add Your Comments to Trace Files

Before you hand your trace files off to another analyst or to a customer, consider adding some notes

on the packets that interest you or on the trace file in general. Trace file and packet comments are

saved with . *pcapng* trace files and can be read in Wireshark version 1.8 and later.

To add a comment to the entire trace file, click the **Annotation** button on the Status Bar, as shown in

Figure 114.

*Figure 114. Click the **Annotation** button on the Status Bar to add a trace file comment.*

Although you can type in any length comment, keep in mind that the trace file size will be affected by

the note size, so don't write a novel in there. If you are going to hand this trace to another analyst who

may add their own comments, consider prefacing your comment with your name, as shown in Figure

115. Wireshark does not keep track of who entered text in this window.

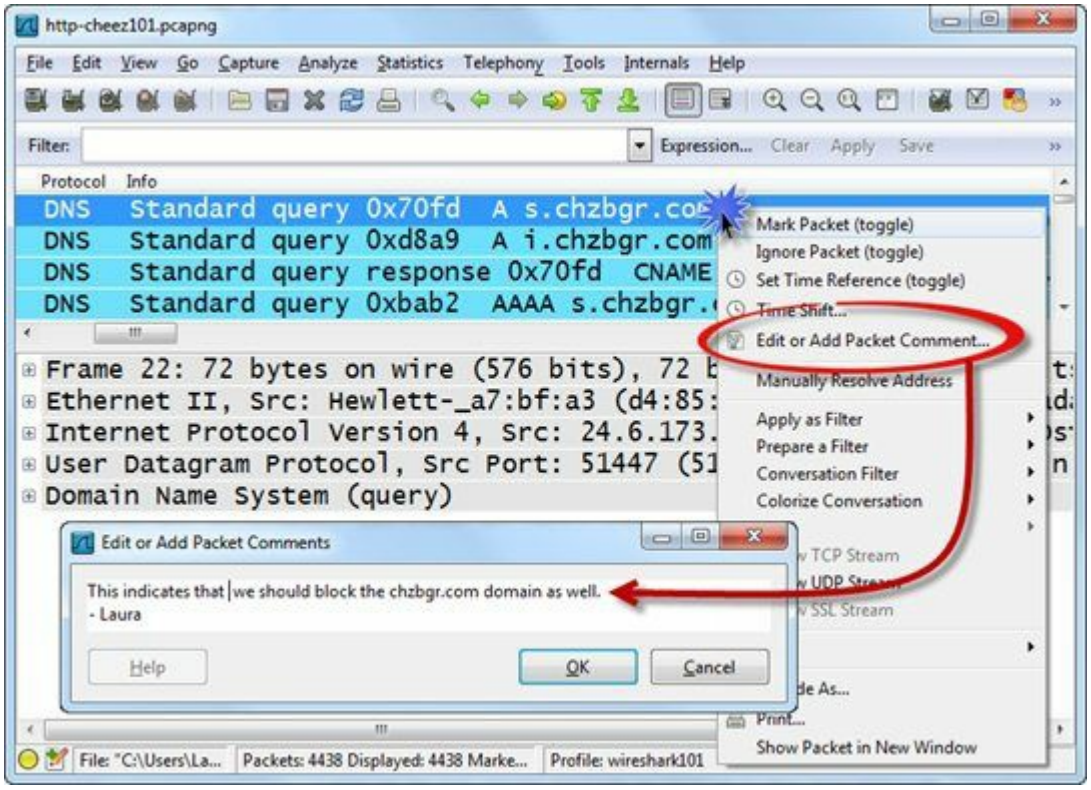
Remember to save your trace file after adding comments. Wireshark places an asterisk in front of the

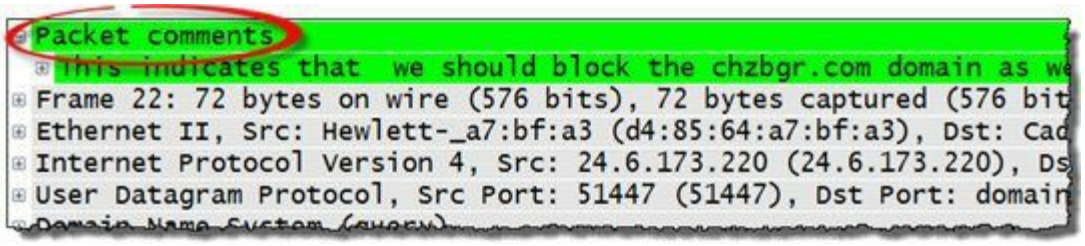
file name in the title bar if there are unsaved comments in a trace file.

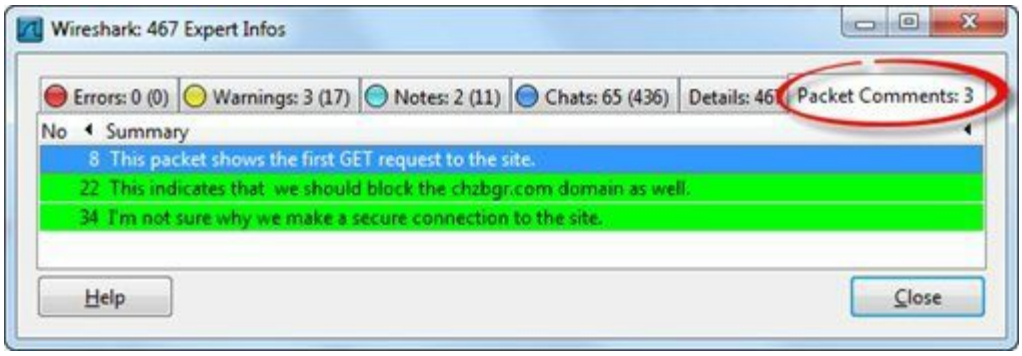
*Figure 115. Type your trace file comments and click **OK**.*

To determine if a file contains trace file comments, click on the **Annotation** button or select **Statistics**

| Summary.


http-cheez101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: Expression... Clear Apply Save
Protocol Info
DNS Standard query 0x70fd A s.chzbgr.com
DNS Standard query 0xd8a9 A i.chzbgr.com
DNS Standard query response 0x70fd CNAME
DNS Standard query 0xbab2 AAAA s.chzbgr.
Frame 22: 72 bytes on wire (576 bits), 72 b
Ethernet II, Src: Hewlett-_a7:bf:a3 (d4:85:
Internet Protocol Version 4, Src: 24.6.173.
User Datagram Protocol, Src Port: 51447 (51
Domain Name System (query)
Mark Packet (toggle)
Ignore Packet (toggle)
Set Time Reference (toggle)
Time Shift...
Edit or Add Packet Comment...
Manually Resolve Address
Apply as Filter
Prepare a Filter
Conversation Filter
Colorize Conversation
Edit or Add Packet Comments
This indicates that we should block the chzbgr.com domain as well.
- Laura
Help
OK
Cancel
Print...
Show Packet in New Window
File: "C:\Users\La... Packets: 4438 Displayed: 4438 Marke... Profile: wireshark101


Packet comments
This indicates that we should block the chzbgr.com domain as we
Frame 22: 72 bytes on wire (576 bits), 72 bytes captured (576 bit
Ethernet II, Src: Hewlett-_a7:bf:a3 (d4:85:64:a7:bf:a3), Dst: Cad
Internet Protocol Version 4, Src: 24.6.173.220 (24.6.173.220), Ds
User Datagram Protocol, Src Port: 51447 (51447), Dst Port: domain
Domain Name System (query)


Wireshark: 467 Expert Infos
Errors: 0 (0)
Warnings: 3 (17)
Notes: 2 (11)
Chats: 65 (436)
Details: 46
Packet Comments: 3
No
Summary
8 This packet shows the first GET request to the site.
22 This indicates that we should block the chzbgr.com domain as well.
34 I'm not sure why we make a secure connection to the site.
Help
Close

7.2. Add Your Comments to Individual

Packets

To add a comment to a single packet, right-click the packet in the Packet List pane and select **Add or**

Edit Packet Comment, as illustrated in Figure 116. Follow the same steps to edit a packet comment.

Figure 116. If people collaborate on analysis, add your name to your packet comments. [http–cheez101.pcapng]

Once you create a packet comment, a new section called Packet comments appears in the Packet

Details window, as shown in Figure 117. The color code for packet comments is a bright green.

Figure 117. Packet comments appear before the Frame section. [http–cheez101.pcapng]

To determine if a trace file contains packet comments, click on the **Expert Infos** button on the Status

Bar and select the **Packet Comments** tab, as shown in Figure 118. Click on a comment once to jump

to that packet. Double-click on a comment to open the comment for viewing or editing.

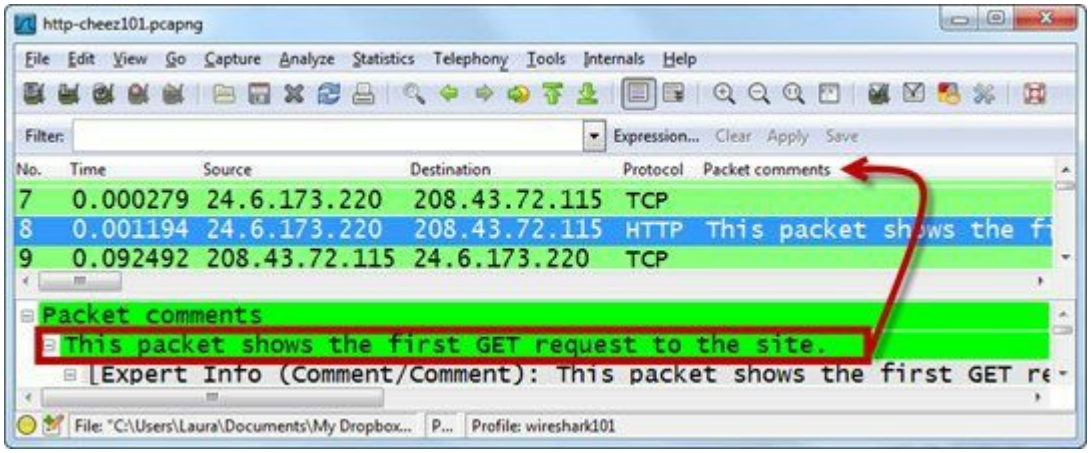
Figure 118. Packet comments are listed in the Expert Infos window. [http–cheez101.pcapng]

Use the .pcapng Format for Annotations

If you opened a trace file that uses an older trace file format (such as .pcap), be sure to save your trace

file in . pcapng format after adding packet or trace file comments. Saving in any other format will

delete all your comments.


http-cheez101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Packet comments
7 0.000279 24.6.173.220 208.43.72.115 TCP
8 0.001194 24.6.173.220 208.43.72.115 HTTP This packet shows the fi
9 0.092492 208.43.72.115 24.6.173.220 TCP
Packet comments
This packet shows the first GET request to the site.
[Expert Info (Comment/Comment): This packet shows the first GET re
File: "C:\Users\Laura\Documents\My Dropbox... P... Profile: wireshark101

Add a Comment Column for Faster Viewing

To view all your comments in the Packet List pane, simply expand the packet comment section in a

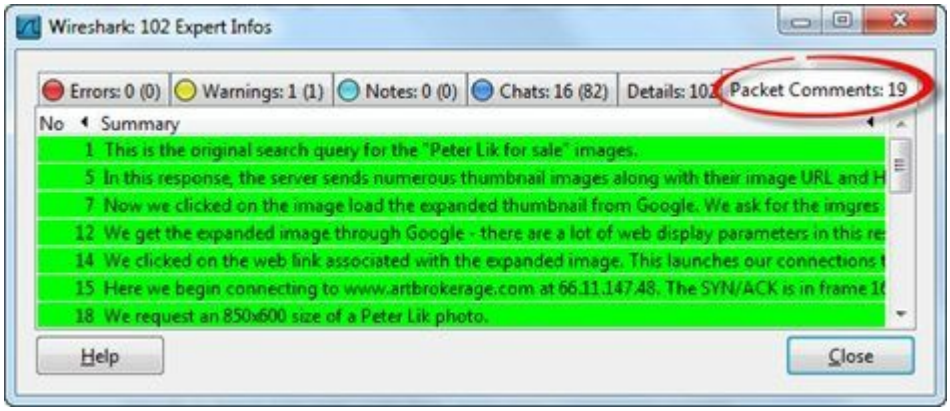
frame that contains comments (frame 8 in *http-cheez101.pcapng,* for example). Right-click on the

actual comment and select **Apply as Column**, as shown in Figure 119.

*Figure 119. Right-click on a comment and select **Apply as Column**. [http–cheez101.pcapng]*

If you add or edit comments to the trace file, you must click the **Save** button to save the file and then

click the **Reload** button to refresh your **Packet comments** column.


Wireshark: 102 Expert Infos
Errors: 0 (0)
Warnings: 1 (1)
Notes: 0 (0)
Chats: 16 (82)
Details: 102
Packet Comments: 19
No
Summary
1 This is the original search query for the "Peter Lik for sale" images.
5 In this response, the server sends numerous thumbnail images along with their image URL and H
7 Now we clicked on the image load the expanded thumbnail from Google. We ask for the imgres
12 We get the expanded image through Google - there are a lot of web display parameters in this re
14 We clicked on the web link associated with the expanded image. This launches our connections t
15 Here we begin connecting to www.artbrokerage.com at 66.11.147.48. The SYN/ACK is in frame 1
18 We request an 850x600 size of a Peter Lik photo.
Help
Close

Lab 40: Read Analysis Notes in a Malicious Redirection

Trace File

It can be a blessing to have notes inside the trace file to assist other analysts (or even you) in

following along with the traffic flow. In this lab you will examine the notes left in a trace file that

contains unusual communications.

Step 1: Open ***sec-suspicous101.pcapng***.

Step 2: Click the **Annotation** button on the Status Bar to read the general notes about this trace file and the suspected malicious redirection.

The trace file annotation recommends that you " *See packet comments for more detail.* "

Click **Cancel** to close the Edit or Add Capture Comments window.

Step 3: Click the **Expert Infos** button and click the **Packet Comments** tab to read the individual comments in the packets in this trace file[51].

Step 4: Click once on any of the comments to jump to that packet in the trace file. Take some time to

read through the trace file and packet comments. You will see when a redirection sends the user to a

malicious site.

Step 5: [Lab Clean-up] When you have finished looking through the packet comments, click the **Close**

button on the Expert Infos window.

Trace file annotations can be very helpful when there are many separate events happening in the trace

file. In Lab 41 we will export all the packet comments in this trace file.

7.3. Export Packet Comments for a Report

If you plan to create a printed report of your analysis findings, consider adding packet comments and

exporting those comments into .txt or .csv format.

As of Wireshark 1.9.0 (which is the development version leading to Wireshark 1.10), you can select

Statistics | Comment Summary | Copy and then paste the comment data into another program

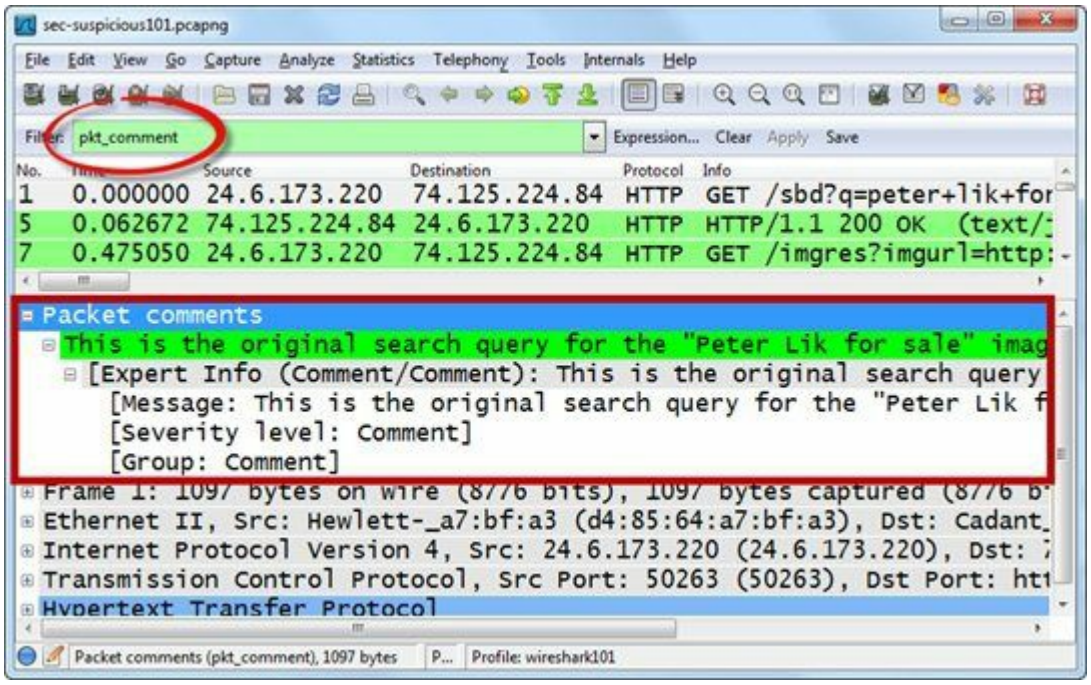
(shown in Figure 123). In Wireshark 1.8.x versions you can use the Export Packet Dissections feature

covered in this section to perform this function.

Although Wireshark 1.9.x and later makes exporting packet and trace file annotations a quick process,

in Lab 41 you will have a chance to practice exporting packet comments using the **Export Packet**

Dissections function. This is a function you should master to export any field values.


sec-suspicious101.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: pkt_comment
Expression... Clear Apply Save
No. Source Destination Protocol Info
1 0.000000 24.6.173.220 74.125.224.84 HTTP GET /sbd?q=peter+lik+for
5 0.062672 74.125.224.84 24.6.173.220 HTTP HTTP/1.1 200 OK (text/
7 0.475050 24.6.173.220 74.125.224.84 HTTP GET /imgres?imgurl=http:
Packet comments
This is the original search query for the "Peter Lik for sale" imag
[Expert Info (Comment/Comment): This is the original search query
[Message: This is the original search query for the "Peter Lik f
[Severity level: Comment]
[Group: Comment]
Frame 1: 1097 bytes on wire (8776 bits), 1097 bytes captured (8776 b
Ethernet II, Src: Hewlett-_a7:bf:a3 (d4:85:64:a7:bf:a3), Dst: Cadant_
Internet Protocol Version 4, Src: 24.6.173.220 (24.6.173.220), Dst:
Transmission Control Protocol, Src Port: 50263 (50263), Dst Port: htt
Hypertext Transfer Protocol
Packet comments (pkt_comment), 1097 bytes
P...
Profile: wireshark101

First, Filter on Packets that Contain Comments

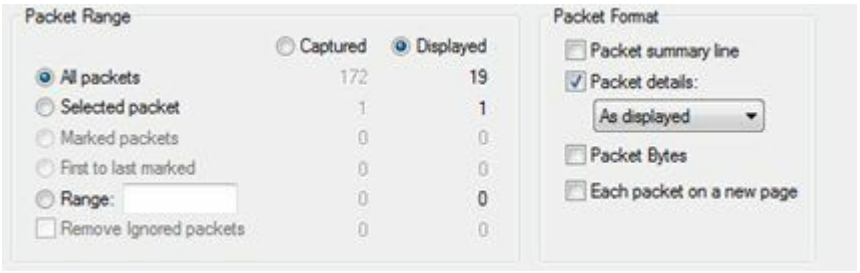
First, apply a pkt_comment filter to your trace file to view only commented packets.

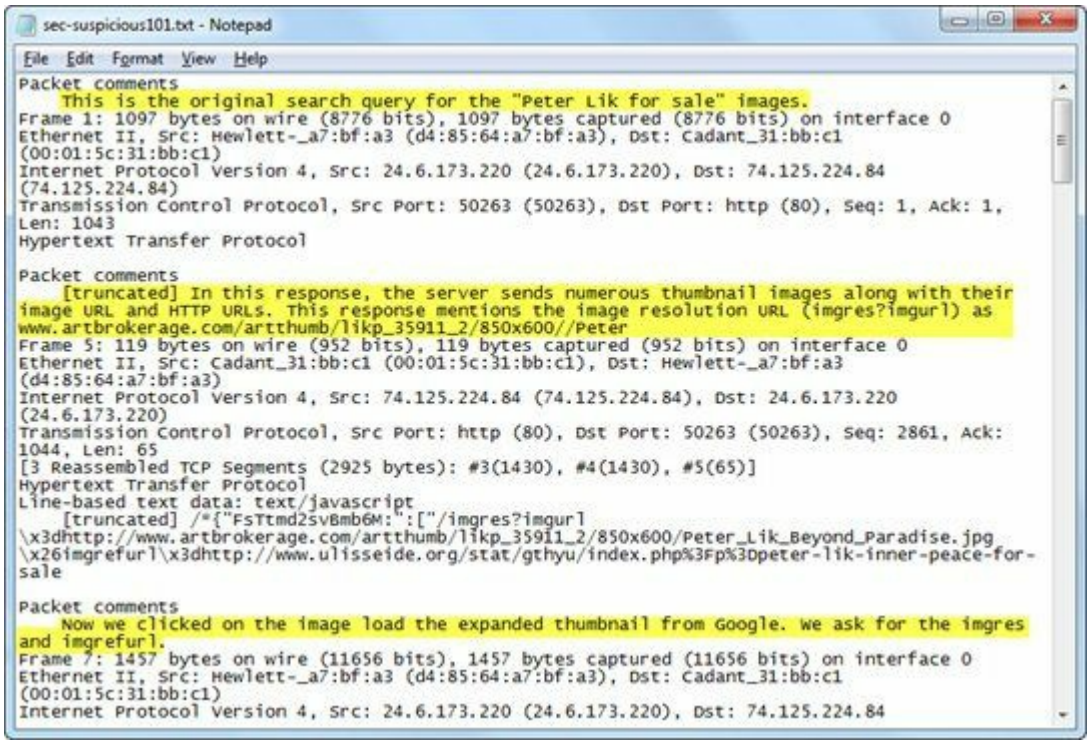
Next, expand the Packet Comments section of any displayed packet. Leave the rest of the packet

compressed, as shown in Figure 120.

Figure 120. Filter on pkt_comment and then expand the Packet comments section of a packet before your export operation.

[sec-suspicious101.pcapng]




sec-suspicious101.txt - Notepad
File Edit Format View Help
Packet comments
This is the original search query for the "Peter Lik for sale" images.
Frame 1: 1097 bytes on wire (8776 bits), 1097 bytes captured (8776 bits) on interface 0
Ethernet II, Src: Hewlett-_a7:bf:a3 (d4:85:64:a7:bf:a3), Dst: Cadant_31:bb:c1
(00:01:5c:31:bb:c1)
Internet Protocol Version 4, Src: 24.6.173.220 (24.6.173.220), Dst: 74.125.224.84
(74.125.224.84)
Transmission Control Protocol, Src Port: 50263 (50263), Dst Port: http (80), Seq: 1, Ack: 1,
Len: 1043
Hypertext Transfer Protocol
Packet comments
[truncated] In this response, the server sends numerous thumbnail images along with their
image URL and HTTP URLs. This response mentions the image resolution URL (imgres?imgurl) as
www.artbrokerage.com/artthumb/likp_35911_2/850x600//Peter
Frame 5: 119 bytes on wire (952 bits), 119 bytes captured (952 bits) on interface 0
Ethernet II, Src: Cadant_31:bb:c1 (00:01:5c:31:bb:c1), Dst: Hewlett-_a7:bf:a3
(d4:85:64:a7:bf:a3)
Internet Protocol Version 4, Src: 74.125.224.84 (74.125.224.84), Dst: 24.6.173.220
(24.6.173.220)
Transmission Control Protocol, Src Port: http (80), Dst Port: 50263 (50263), Seq: 2861, Ack:
1044, Len: 65
[3 Reassembled TCP Segments (2925 bytes): #3(1430), #4(1430), #5(65)]
Hypertext Transfer Protocol
Line-based text data: text/javascript
[truncated] /*{"FsTtmd2svBmb6M:":["/imgres?imgurl
\x3dhttp://www.artbrokerage.com/artthumb/likp_35911_2/850x600/Peter_Lik_Beyond_Paradise.jpg
\x26imgrefurl\x3dhttp://www.ulisseide.org/stat/gthyu/index.php%3Fp%3Dpeter-lik-inner-peace-for-
sale
Packet comments
Now we clicked on the image load the expanded thumbnail from Google. We ask for the imgres
and imgrefurl.
Frame 7: 1457 bytes on wire (11656 bits), 1457 bytes captured (11656 bits) on interface 0
Ethernet II, Src: Hewlett-_a7:bf:a3 (d4:85:64:a7:bf:a3), Dst: Cadant_31:bb:c1
(00:01:5c:31:bb:c1)
Internet Protocol Version 4, Src: 24.6.173.220 (24.6.173.220), Dst: 74.125.224.84

Next, Export Packet Dissections as Plain Text

Select **File | Export Packet Dissections | as "Plain Text" file** and choose **All packets (Displayed), Packet details (As displayed)**, as shown in Figure 121. Uncheck the Packet summary checkbox.

Consider naming your text file with the same stem as the trace file. For example, if your trace file is

sec–suspicious101.pcapng, name your text file *sec–suspicious101.txt*.

Figure 121. Set up your export to include displayed packets and only the Packet details "As displayed".

The result will be a file that includes packet comments preceding the Frame summary of each packet,

as shown in Figure 122.

Figure 122. Export your packet comments into a .txt file to copy into a report.

In Wireshark 1.8.x, only 65 characters of the Packet Comments field are exported.

As mentioned earlier, Wireshark 1.9.x and later offers a **Statistics | Comments Summary | Copy**

feature to export all packet comments and basic trace file statistics. Figure 123 shows the Comments

Summary window. Simply click the **Copy** button to buffer the contents of this window and paste the

contents into another program.

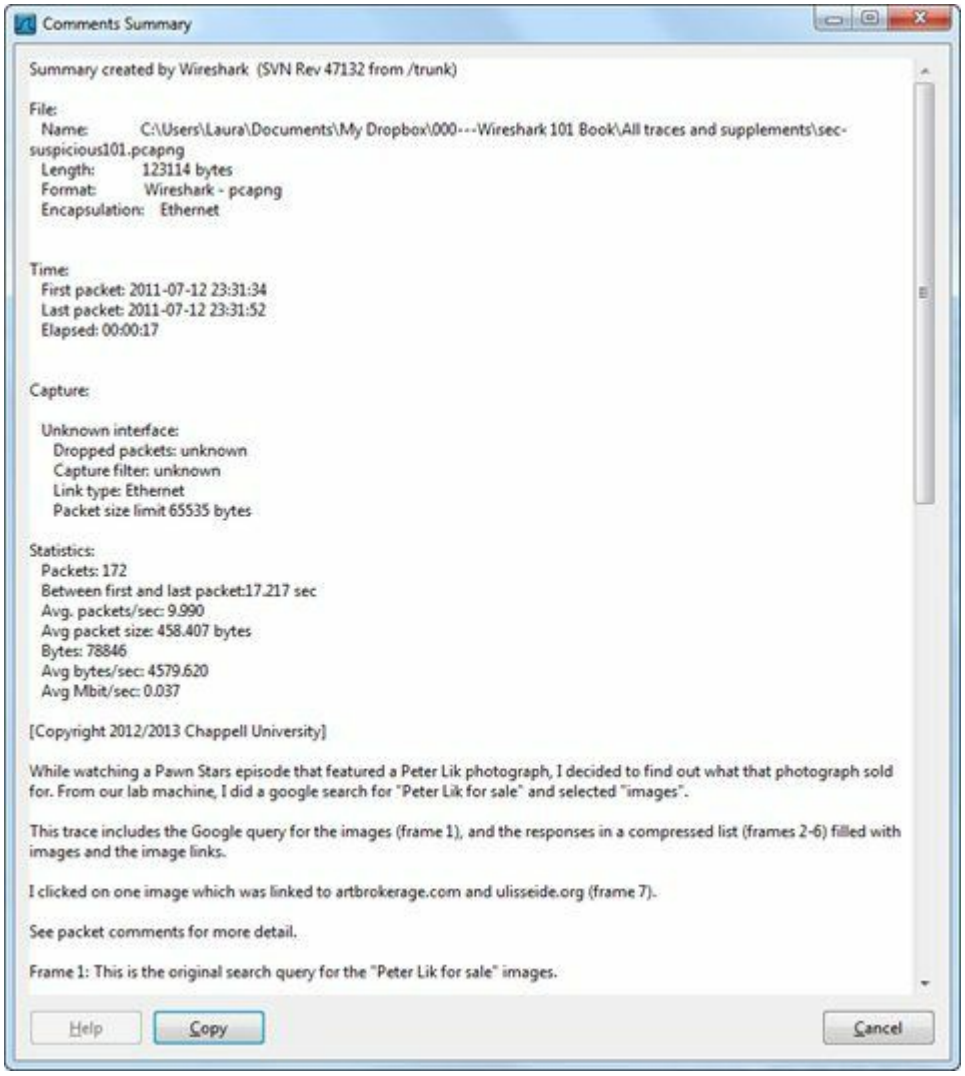
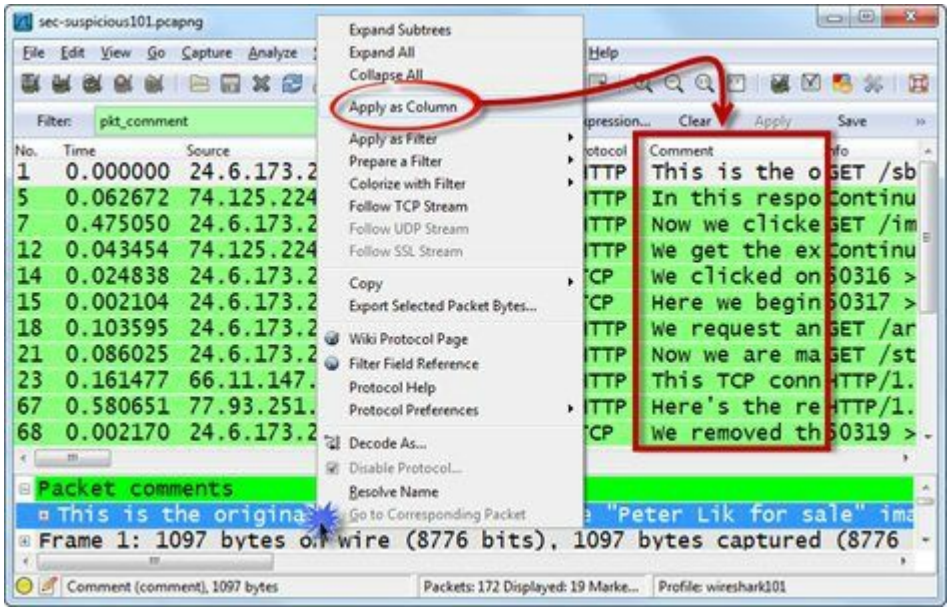

Comments Summary
Summary created by Wireshark (SVN Rev 47132 from /trunk)
File:
Name: C:\Users\Laura\Documents\My Dropbox\000---Wireshark 101 Book\All traces and supplements\sec-suspicious101.pcapng
Length: 123114 bytes
Format: Wireshark - pcapng
Encapsulation: Ethernet
Time:
First packet: 2011-07-12 23:31:34
Last packet: 2011-07-12 23:31:52
Elapsed: 00:00:17
Capture:
Unknown interface:
Dropped packets: unknown
Capture filter: unknown
Link type: Ethernet
Packet size limit 65535 bytes
Statistics:
Packets: 172
Between first and last packet:17.217 sec
Avg. packets/sec: 9.990
Avg packet size: 458.407 bytes
Bytes: 78846
Avg bytes/sec: 4579.620
Avg Mbit/sec: 0.037
[Copyright 2012/2013 Chappell University]
While watching a Pawn Stars episode that featured a Peter Lik photograph, I decided to find out what that photograph sold for. From our lab machine, I did a google search for "Peter Lik for sale" and selected "images".
This trace includes the Google query for the images (frame 1), and the responses in a compressed list (frames 2-6) filled with images and the image links.
I clicked on one image which was linked to artbrokerage.com and ulisseide.org (frame 7).
See packet comments for more detail.
Frame 1: This is the original search query for the "Peter Lik for sale" images.
Help
Copy
Cancel

*Figure 123. To quickly export trace file and packet comments, use the **Statistics | Comments Summary** in Wireshark 1.9.x and later.*

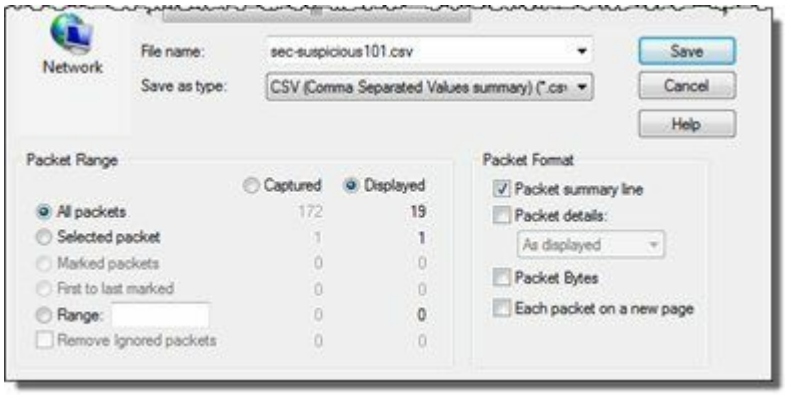
Since Wireshark supports packet and file anotations, consider building your troubleshooting and

network forensics reports directly in Wireshark by adding comments in the trace files. When you have

finished annotating your findings, export your packet comments for quick inclusion in your reports.



TIP



Lab 41: Export Malicious Redirection Packet Comments

We will use the *sec-suspicious101.pcapng* trace file again in this lab. We will use a two-step process

for comment export. First we will prepare the trace file to export the field information we are most

interested in. We will export the fields in text format. Unlike in the previous section, we will export

the packet comments using the Packet summary line.

Step 1: Open ***sec-suspicious101.pcapng****.*

Step 2: In frame 1, right-click on the **Packet comments** line in the Packet Details area and select

Apply as Filter | Selected. Only 19 packets should match your display filter.

Step 3: Now expand the Packet comments section of frame 1. Right-click on the actual comment

starting with **" This is the original... "** and select **Apply as Column**.

Step 4: Select **File | Export Packet Dissections | as "CSV" (Comma Separated Values packet**

summary) file.

If you find yourself building many reports detailing your analysis findings, consider looking

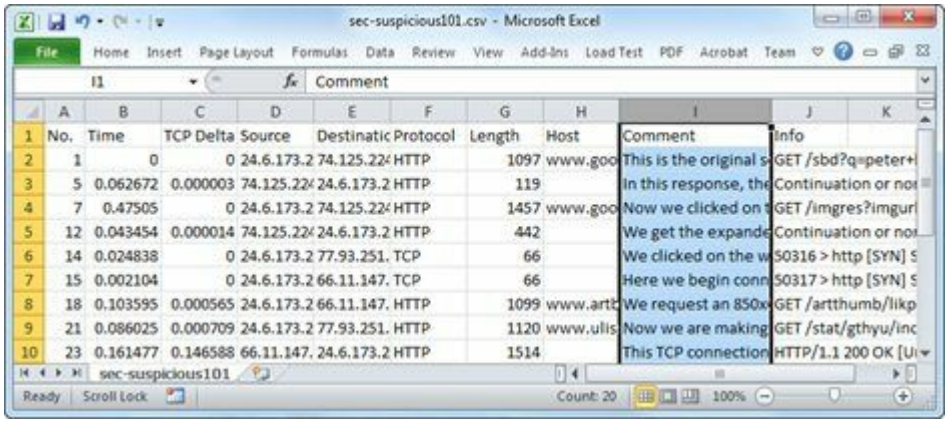
into Cascade Pilot by Riverbed (see Consider a Different Solution—Cascade Pilot®). This

product was designed to accept comments and export the comments into a report along with

charts and graphs depicting the traffic patterns.

Step 5: Navigate to the directory where you want to save your text file and name your file ***sec-***

suspicous101.csv. Ensure **Displayed** and **Packet summary line** are selected before clicking **Save**.


sec-suspicious101.csv - Microsoft Excel
Comment
No. Time TCP Delta Source Destinatic Protocol Length Host Comment Info
sec-suspicious101
Ready Scroll Lock Count: 20 100%

Step 6: Open your **CSV file** in a spreadsheet program to review the exported information. You will

notice that your hidden columns are exported as well. This is a good reason to keep your hidden

column count to a minimum. If you just have too many hidden columns, you could simply switch to a

nice, clean profile and export a CSV file from there.

Step 7: Lab Clean-up Return to Wireshark and click the **Clear** button to remove your display filter.

Right-click on your **Comment** column heading and select **Remove Column** or Hide Column if you

wish to retain this column for later use.

You should master the skill of adding columns to use for exported reports. As mentioned at the

beginning of this section, although Wireshark 1.9.x and later supports a simple **Statistics | Comment**

Summary | Copy feature to make exporting comments simple, you will still need to use this

technique to export other packet fields.

Chapter 7 Challenge

Open *challenge101-7.pcapng* and use the techniques covered in this chapter to answer these Challenge

questions. The answer key is located in Appendix A.

Question 7-1.

What information is contained in the trace file annotation?

Question 7-2.

What packet comments are contained in this trace file?

Question 7-3.

Add a comment to the POST message in this trace file. What packet did you alter?

Chapter 8 Skills: Use Command-Line Tools

to Capture, Split, and Merge Traffic

"Network communication is a conversation. We don't usually think about the subtle rules of human

conversation: what to say first, next, and when we can say that, and when it's going to be rude,

impolite, and maybe cause our partner to quit talking. Once we learn the rules of the protocols and

know what the calls and responses should be, we can examine what actually happened and see where

things went wrong. The better we know the etymology and anthropology of the protocols, the better we

understand the trace."

John Gonder

Cisco Academy Director, Las Positas College

Quick Reference: Command-Line Tools Key Options

EDITCAP

editcap –h: View Editcap parameters.

editcap –i 360 big.pcapng 360secs.pcapng: Split *big.pcapng* into separate

360secs.pcapng* files with up to 360 seconds of traffic in each file.

editcap –c 500 big.pcapng 500pkts.pcapng: Split *big.pcapng* into separate

500pkts.pcapng* files with up to 500 packets in each file.

MERGECAP

mergecap –h: View Mergecap parameters.

mergecap files*.pcapng –w merged.pcapng: Merge *files*.pcapng* into a single file

called *merged.pcapng* (merge based on packet timestamps).

mergecap a.pcapng b.pcapng –w ab.pcapng –a: Merge *a.pcapng* and *b.pcapng*

into a single file called *ab.pcapng* (merge based on the order files are listed).

TSHARK

tshark –h: View Tshark parameters.

tshark –D: List the available capture interfaces that can be used with the –i parameter.

tshark –i2 –f "tcp" –w tcp.pcapng: Capture only TCP-based traffic on interface 2

and save it to *tcp.pcapng*.

tshark –i1 –R "ip.addr==10.2.1.1": Capture all traffic on interface 1, but only

display traffic to or from 10.2.1.1.

tshark –r "myfile.pcapng" –R "http.host contains ".ru"" –w myfile-

ru.pcapng: Open a trace file called *myfile.pcapng* and apply a display filter for the value ".ru"

in the HTTP host field—save the results to a file called *myfile-ru.pcapng.*

8.1. Split a Large Trace File into a File Set

Wireshark can become sluggish or even non-responsive when working with large trace files. Once you

get above that 100 MB size, applying display filters, adding columns, and building graphs may be too

slow. Consider splitting larger files into file sets for faster analysis. File sets are groups of trace files

that begin with a common stem name, trace file number as well as a time and date stamp.

Add the Wireshark Program Directory to Your Path[52]

Use Editcap to split a large file into smaller files that are linked together. Editcap.exe is located in the

Wireshark program file directory (see **Help | About Wireshark | Folders** to locate this directory). To

use Editcap (or any of the included command-line tools) from any directory, add the Wireshark

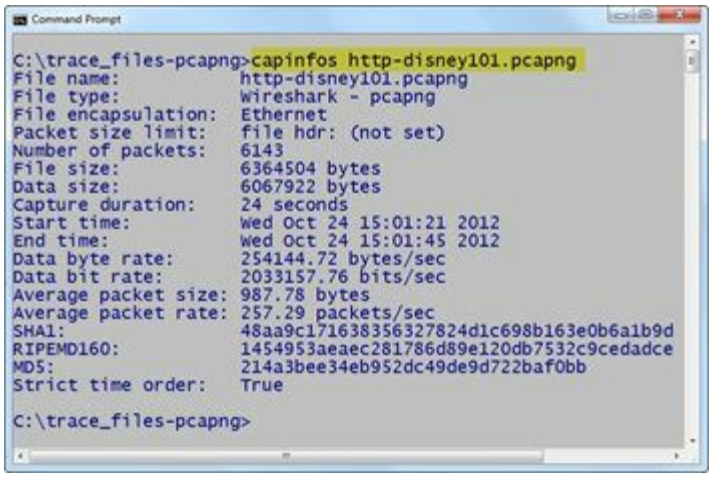
program directory to your path.

Once you've added the Wireshark program directory to your path, open the command prompt/terminal

window and navigate to the folder that contains the large file that you want to split into a file set. Type

editcap –h to view all Editcap parameters. You can split a file based on number of packets (-c

option) or amount of time in seconds (–i option).


Command Prompt
C:\trace_files-pcapng>capinfos http-disney101.pcapng
File name: http-disney101.pcapng
File type: Wireshark - pcapng
File encapsulation: Ethernet
Packet size limit: file hdr: (not set)
Number of packets: 6143
File size: 6364504 bytes
Data size: 6067922 bytes
Capture duration: 24 seconds
Start time: Wed Oct 24 15:01:21 2012
End time: Wed Oct 24 15:01:45 2012
Data byte rate: 254144.72 bytes/sec
Data bit rate: 2033157.76 bits/sec
Average packet size: 987.78 bytes
Average packet rate: 257.29 packets/sec
SHA1: 48aa9c171638356327824d1c698b163e0b6a1b9d
RIPEMD160: 1454953aeaec281786d89e120db7532c9cedadce
MD5: 214a3bee34eb952dc49de9d722baf0bb
Strict time order: True
C:\trace_files-pcapng>

Use Capinfos to Get the File Size and Packet Count

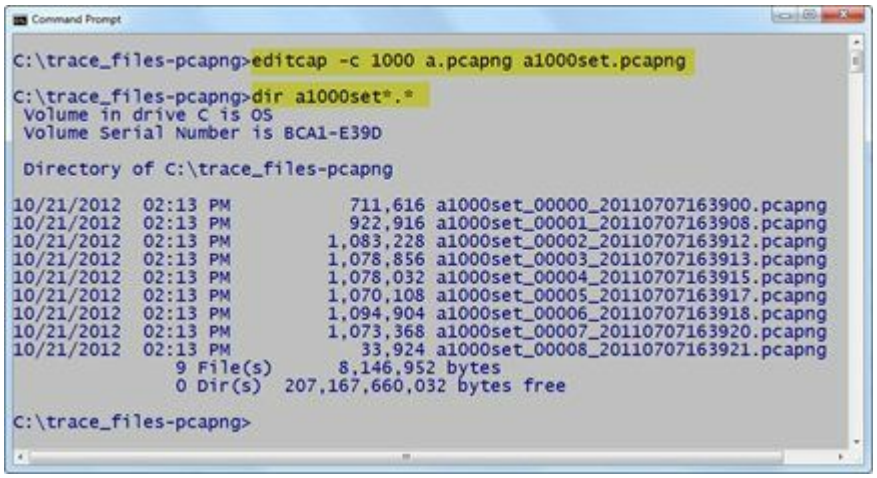
Capinfos is a command-line tool that provides basic information about trace files, as shown in Figure

124. Capinfos is included with Wireshark. It resides in the Wireshark program directory. The syntax

for Capinfos is simply capinfos < *filename*> . Use Capinfos to find the capture duration

(seconds) and packet count of a trace file before splitting it. We will use Capinfos again in Lab 42.

Figure 124. Use Capinfos to obtain basic trace file information before splitting the file. [http–disney101.pcapng]



Split a File Based on Packets per Trace File

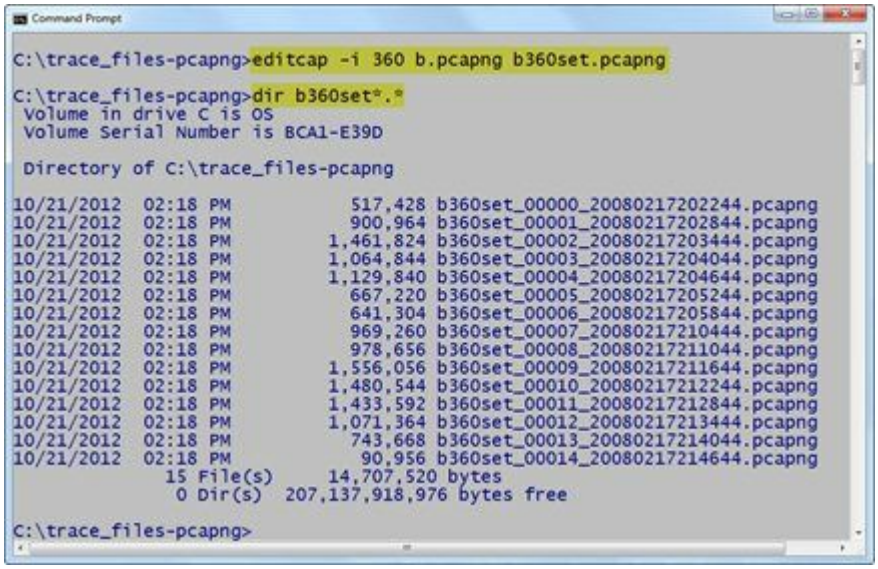
In Figure 125, we typed editcap –c 1000 a.pcapng a1000set.pcapng to split a single

trace file called *a.pcapng* into a set of files (*a1000set*.pcapng*) that contain a maximum of 1,000

packets each. The last trace file of the set will likely have less than 1,000 packets unless the original

file ended on a 1,000-packet count boundary.

Figure 125. Use the –c parameter to split a trace file based on packet count.



Split a File Based on Seconds per Trace File

In Figure 126, we typed editcap –i 360 b.pcapng b360set.pcapng to split a single trace

file called *b.pcapng* into a set of files (*b360set*.pcapng*) that contain up to 360 seconds of traffic each.

Wireshark will not split a packet in half at the 360 second mark, so your files may have slightly less

than 360 seconds of traffic in them.

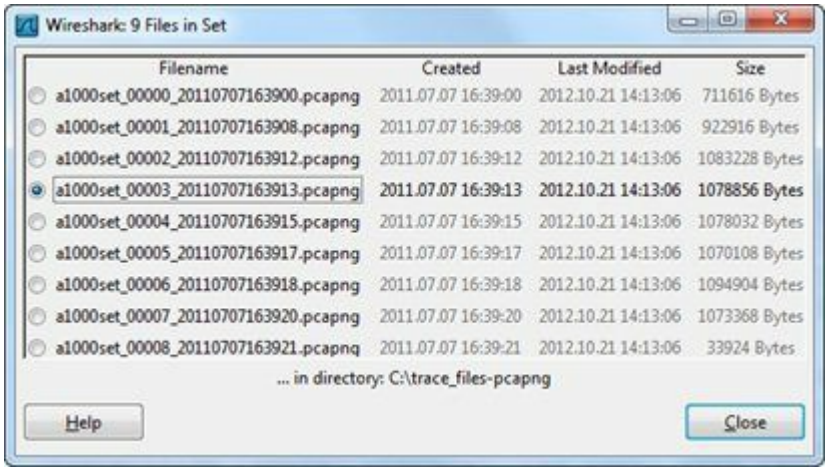
The last trace file of the set will likely have less than 360 seconds of traffic in it unless the original

file ended on a six minute boundary.

In our example, Editcap split our *b.pcapng* trace file into 15 linked trace files numbered 00000 to

00014.

Figure 126. Use the –i parameter to split a trace file based on number of seconds.



Open and Work with File Sets in Wireshark

When working with file sets in Wireshark, open any file of a file set using **File | Open**. Then use **File |**

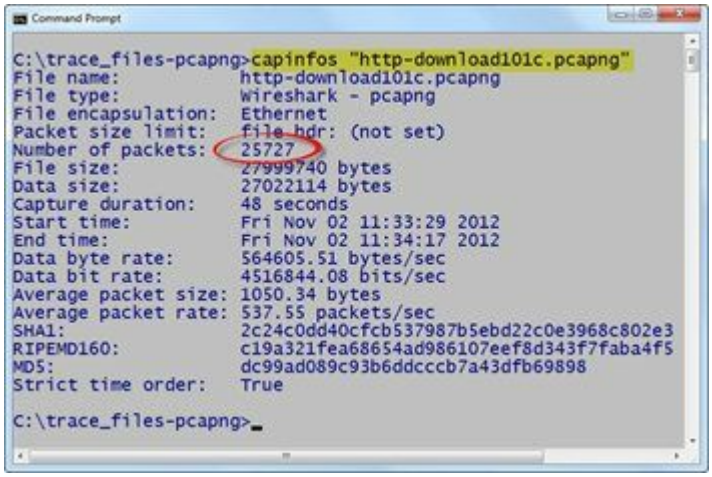
File Set | List Files to switch between files of a file set quickly.

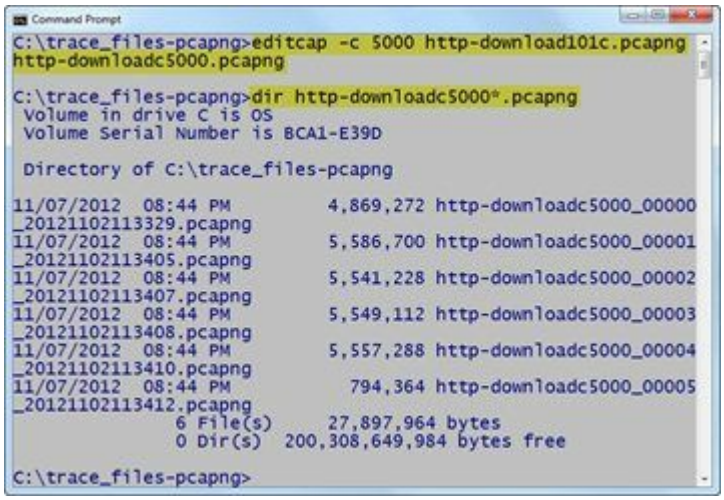
In Figure 127, we are looking at the file list for a file set that contains 9 files. Click on the radio button

in front of any file listed to open that file quickly. If you have display filters in place, those display

filters will be applied to each file you open.

Figure 127. Click a radio button to open another file in a file set.


Command Prompt
C:\trace_files-pcapng>capinfos "http-download101c.pcapng"
File name: http-download101c.pcapng
File type: Wireshark - pcapng
File encapsulation: Ethernet
Packet size limit: file hdr: (not set)
Number of packets: 25727
File size: 27999740 bytes
Data size: 27022114 bytes
Capture duration: 48 seconds
Start time: Fri Nov 02 11:33:29 2012
End time: Fri Nov 02 11:34:17 2012
Data byte rate: 564605.51 bytes/sec
Data bit rate: 4516844.08 bits/sec
Average packet size: 1050.34 bytes
Average packet rate: 537.55 packets/sec
SHA1: 2c24c0dd40cfcb537987b5ebd22c0e3968c802e3
RIPEMD160: c19a321fea68654ad986107eef8d343f7faba4f5
MD5: dc99ad089c93b6ddcccb7a43dfb69898
Strict time order: True
C:\trace_files-pcapng>


Command Prompt
C:\trace_files-pcapng>editcap -c 5000 http-download101c.pcapng http-downloadc5000.pcapng
C:\trace_files-pcapng>dir http-downloadc5000*.pcapng
Volume in drive C is OS
Volume Serial Number is BCA1-E39D
Directory of C:\trace_files-pcapng
11/07/2012 08:44 PM 4,869,272 http-downloadc5000_00000_20121102113329.pcapng
11/07/2012 08:44 PM 5,586,700 http-downloadc5000_00001_20121102113405.pcapng
11/07/2012 08:44 PM 5,541,228 http-downloadc5000_00002_20121102113407.pcapng
11/07/2012 08:44 PM 5,549,112 http-downloadc5000_00003_20121102113408.pcapng
11/07/2012 08:44 PM 5,557,288 http-downloadc5000_00004_20121102113410.pcapng
11/07/2012 08:44 PM 794,364 http-downloadc5000_00005_20121102113412.pcapng
6 File(s) 27,897,964 bytes
0 Dir(s) 200,308,649,984 bytes free
C:\trace_files-pcapng>

Lab 42: Split a File and Work with Filtered File Sets

You will be working with *http–download101c.pcapng* in this lab. This trace file is only 27 MB, but we

will use it to practice splitting a file. After splitting the file, we will move through the file set while a

display filter is applied. Wireshark automatically applies the display filter to each file as it is opened.

Step 1: Open the **command prompt** (Windows) or a **terminal window** (Linux/Macintosh).

Step 2: Navigate to your trace file directory[53]. You will be working with *http–download101c.pcapng* in this lab.

Step 3: We are going to split this file based on the packet count. Type **capinfos "http-**

download101c.pcapng" [54].

This file contains is 25,727 packets. We will split this trace file into a file set containing up to 5,000

packets in each file.

Step 4: Type **editcap –c 5000 http-download101c.pcapng http–**

downloadc5000.pcapng. Press **enter**. Wireshark will create 6 files which begin with *http-*

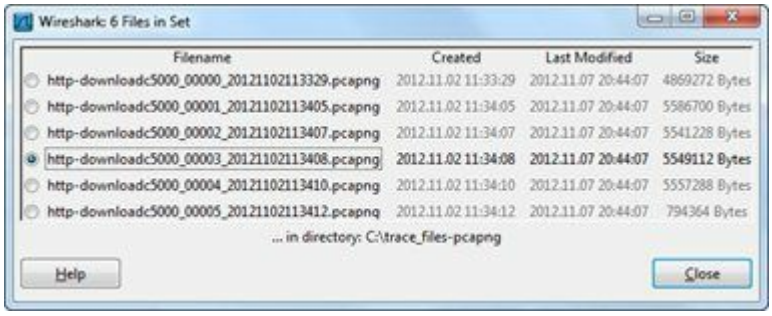
downloadc5000 and contain a file number followed by a date and timestamp, as shown below.

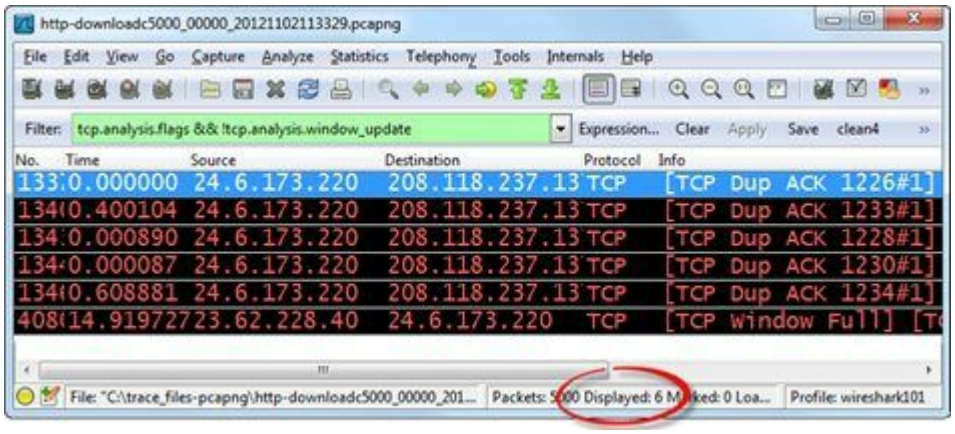
Step 5: Launch Wireshark and select **File | Open** and select the file numbered " ***_00003***" from the file set you created in Step 4.

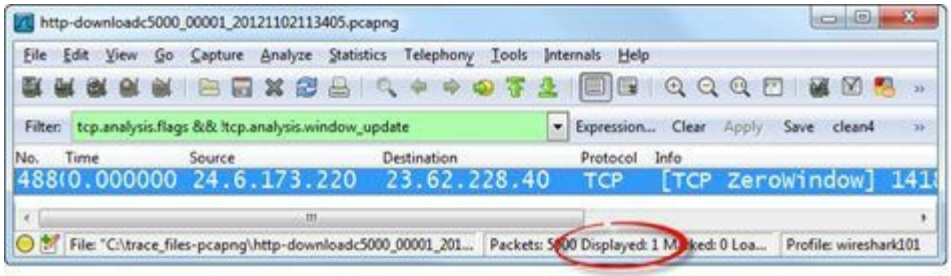
Step 6: Type **tcp.analysis.flags && !tcp.analysis.window_update** in the display

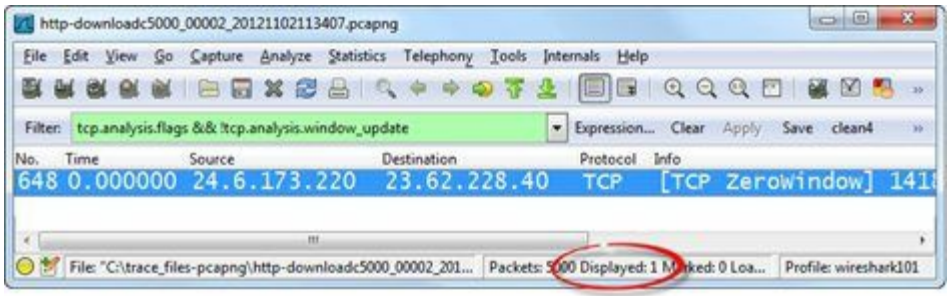
filter area. None of the packets in the _00003 file match our filter, as shown below.

http-downloadc5000_00003_20121102113408.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: tcp.analysis.flags && !tcp.analysis.window_update
Expression... Clear Apply Save clean4
No. Time Source Destination Protocol Info
File: "C:\trace_files-pcapng\http-downloadc5000_00003_201...
Packets: 5000 Displayed: 0 Marked: 0 Loa...
Profile: wireshark101




http-downloadc5000_00000_20121102113329.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: tcp.analysis.flags && !tcp.analysis.window_update
Expression... Clear Apply Save clean4
No. Time Source Destination Protocol Info
133 0.000000 24.6.173.220 208.118.237.13 TCP [TCP Dup ACK 1226#1]
134 0.400104 24.6.173.220 208.118.237.13 TCP [TCP Dup ACK 1233#1]
134 0.000890 24.6.173.220 208.118.237.13 TCP [TCP Dup ACK 1228#1]
134 0.000087 24.6.173.220 208.118.237.13 TCP [TCP Dup ACK 1230#1]
134 0.608881 24.6.173.220 208.118.237.13 TCP [TCP Dup ACK 1234#1]
408 14.919727 23.62.228.40 24.6.173.220 TCP [TCP Window Full] [T
Profile: wireshark101


http-downloadc5000_00001_20121102113405.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: tcp.analysis.flags && !tcp.analysis.window_update
Expression... Clear Apply Save clean4
No. Time Source Destination Protocol Info
488 0.000000 24.6.173.220 23.62.228.40 TCP [TCP ZeroWindow] 141
Profile: wireshark101


http-downloadc5000_00002_20121102113407.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: tcp.analysis.flags && !tcp.analysis.window_update
Expression... Clear Apply Save clean4
No. Time Source Destination Protocol Info
648 0.000000 24.6.173.220 23.62.228.40 TCP [TCP ZeroWindow] 141
Profile: wireshark101

Step 7: Select **File | File Set | List Files**. Click on each radio button to browse the files.

Wireshark applies the current display filter as you open the various files. It appears only the files

numbered "00000," "00001," and "00002" contain these flagged TCP packets.

As you move through the files, look at the Status Bar to determine how many packets matched your

filter in each of the trace files.

Step 8: Lab Clean-up Click the **Close** button on the File Set window and then click the **Clear** button to remove your display filter.

Since Wireshark maintains the display filter setting as you move through files within a file set, it is

easy to determine how many packets matched the filter.

8.2. Merge Multiple Trace Files

You may want to merge several smaller files to create an IO Graph of all the traffic, save time

applying display filters to look for key words, or launch the Protocol Hierarchy window to detect

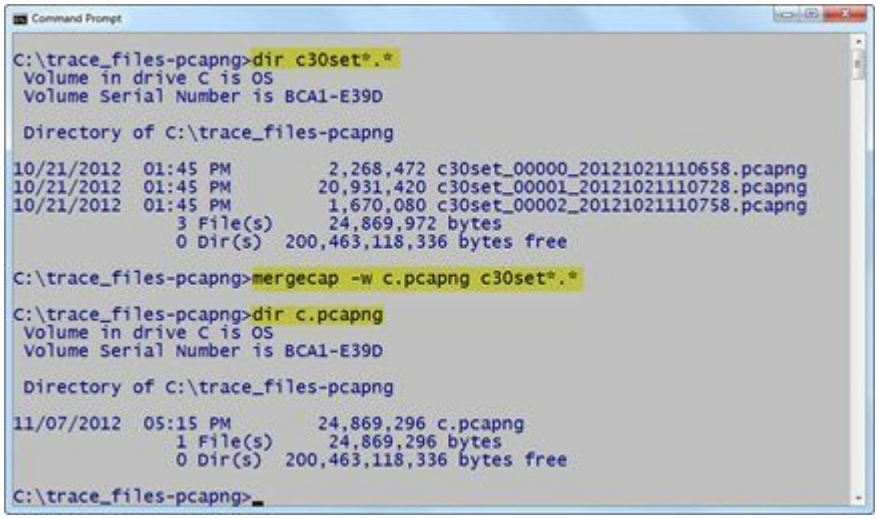
suspicious protocols or applications.

Ensure the Wireshark Program Directory is in Your Path

Use Mergecap to combine smaller files into one larger file. Mergecap.exe is located in the Wireshark

program file directory (see **Help | About Wireshark | Folders | Program** to locate this directory).

To use Mergecap from any directory, add the Wireshark program directory to your path.


Command Prompt
C:\trace_files-pcapng>dir c30set*.*
Volume in drive C is OS
Volume Serial Number is BCA1-E39D
Directory of C:\trace_files-pcapng
10/21/2012 01:45 PM 2,268,472 c30set_00000_20121021110658.pcapng
10/21/2012 01:45 PM 20,931,420 c30set_00001_20121021110728.pcapng
10/21/2012 01:45 PM 1,670,080 c30set_00002_20121021110758.pcapng
3 File(s) 24,869,972 bytes
0 Dir(s) 200,463,118,336 bytes free
C:\trace_files-pcapng>mergecap -w c.pcapng c30set*.*
C:\trace_files-pcapng>dir c.pcapng
Volume in drive C is OS
Volume Serial Number is BCA1-E39D
Directory of C:\trace_files-pcapng
11/07/2012 05:15 PM 24,869,296 c.pcapng
1 File(s) 24,869,296 bytes
0 Dir(s) 200,463,118,336 bytes free
C:\trace_files-pcapng>

Run Mergecap with the –w Parameter

Assuming you've added the Wireshark program directory to your path, open the command prompt and

navigate to the folder that contains the files you want to merge. Type **mergecap –h** to view all

Mergecap parameters.

You can merge a file based on frame timestamps (the default) or use the –a parameter to merge the

files based on the order in which you list them during the merge process. Use the –w parameter write

the new merged file to disk. In Figure 128, we created a file called *c.pcapng* by merging all files that

have name starting with *c30set*.

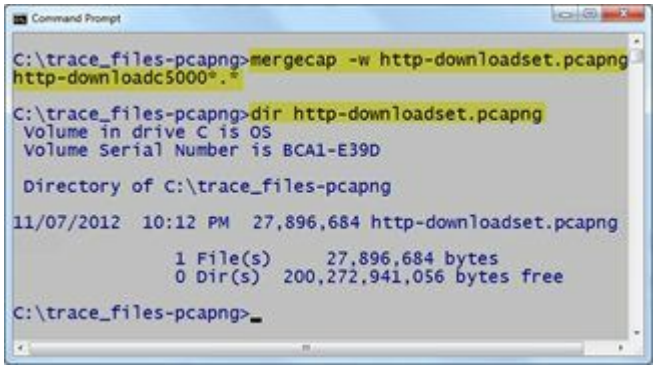
Figure 128. Use Mergecap to combine trace files based on frame timestamps.

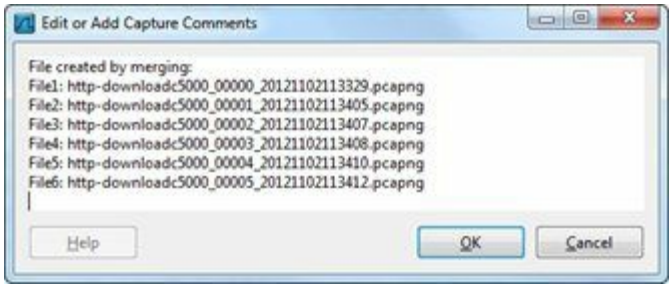
You will notice that the merged file is smaller than the sum of bytes of the separate trace files. This

change in file size is because there is only one trace file header in the new file instead of the three

trace file headers counted in the total bytes count before the merge.

In Lab 43 you will get a chance to try out this merging skill.





Lab 43: Merge a Set of Files using a Wildcard

In this lab you will merge the six-file *http-downloadc5000*.pcapng* set that you created in Lab 42.

You will use a wildcard to make this process a bit easier and less error-prone.

Step 1: Open the **command prompt** (Windows) or a **terminal window** (Linux/Macintosh).

Step 2: Navigate to your trace file directory. Type **dir http-downloadc5000*.*** to view the

trace files you created in Lab 42.

Step 3: Type **mergecap –w http-downloadset.pcapng http–downloadc5000*.***.

Press **enter**.

Type **dir http-downloadset.pcapng** to view your new file.

If you compare the size of http-downloadc5000.pcapng to http-download101c.pcapng, you will notice

a size difference. During the file splitting process, the trace file annotation is removed. During the

merging process a new trace file annotation is created that lists the merged files as shown in the image

below.

In this lab exercise, you used the default setting for the order of the merged files—merge based on

packet timestamps. If you wanted to merge the files in a particular order, you must use the –a

parameter and list each trace file in the order you want them to be merged.

8.3. Capture Traffic at Command Line

Use *dumpcap.exe* or *tshark.exe* to capture traffic at the command line when Wireshark can't keep up with the traffic (drops appear on the Status Bar), or you are deploying a streamlined remote capture

host, or you are scripting an unattended capture.

Dumpcap or Tshark?

This is an interesting question. dumpcap is a capture tool only. When you run Tshark, it actually calls

dumpcap.exe for capture functionality. Tshark contains extra post-capture parameters which makes it

a better option for many situations. If you are really struggling with memory limitations, just use

dumpcap directly. Otherwise, Tshark is the answer.

You can run either tool at the command line to capture traffic to . *pcapng* files. Both tools are located in the Wireshark program file directory (see **Help | About Wireshark | Folders | Program** to locate

this directory). Both can use capture filters and various other capture settings.

To use dumpcap or Tshark from any directory, add the Wireshark program directory to your path[55].

Open the command prompt/terminal window and navigate to the folder where you want to save trace

files. Run both tools from this directory.

Command Prompt
C:\traces-general>dumpcap -D
1. \\.\airpcap00 (AirPcap USB wireless capture adapter nr. 00)
2. \\.\airpcap_any (AirPcap Multi-Channel Aggregator)
3. \\.\airpcap01 (AirPcap USB wireless capture adapter nr. 01)
4 \Device\NPF_{6E79FEC0-FF79-4970-96E4-EEFF300A9B9F} (Realtek
C:\traces-general>

Capture at the Command Line with Dumpcap

Type dumpcap –h to view dumpcap parameters.

Type dumpcap –D to view your available interfaces, as shown in Figure 129. Use the number

preceding the interface name when you capture. In the image below, we can use **1**, **2**, **3**, or **4** to select an interface for capture.

*Figure 129. Use **dumpcap –D** to view available interfaces.*

Use the –c option to stop capturing after a certain number of packets have been captured. For

example, dumpcap –c 2000 –w smallcap.pcapng will automatically stop the capture after

2,000 packets have been captured to a file called *smallcap.pcapng*.

Use the –a option with duration: *n* (seconds) or filesize: *n* (KB) to stop capturing after a

certain number of seconds have elapsed or until your trace file has reached a certain size. For

example, in Figure 130 we typed dumpcap –i1 –a filesize:1000 –w 1000kb.pcapng to

automatically stop the capture as soon as the file size reaches 1000 KB.

Figure 130. Use –a with an autostop condition such as filesize:1000.

Capture at the Command Line with Tshark

Tshark relies on dumpcap to capture traffic, so when you type tshark –c 100 –

w 100.pcapng, Tshark launches dumpcap to do the actual capturing.

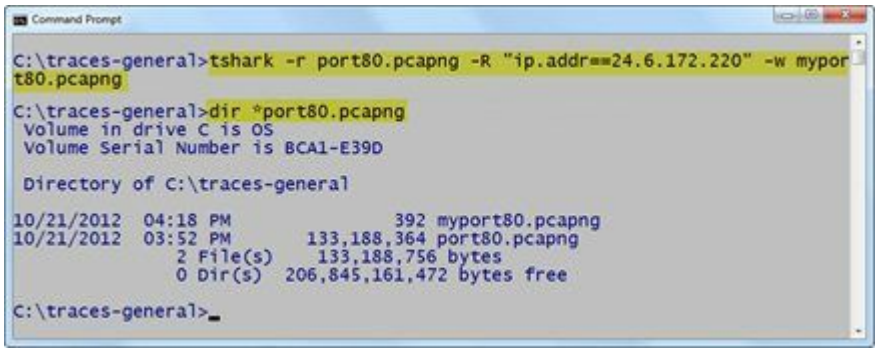
Tshark can be used for command-line capture, but it also offers some processing options for existing

trace files. Use tshark –h to explore more possibilities for command-line capture with Tshark.

Use tshark –D to view the available interfaces. Just as you did with dumpcap, use the number

preceding the interface name with the –i parameter when capturing. Use –w to define the name of

your capture file and –a with autostop parameters.


Command Prompt
C:\traces-general>tshark -r port80.pcapng -R "ip.addr==24.6.172.220" -w myport80.pcapng
C:\traces-general>dir *port80.pcapng
Volume in drive C is OS
Volume Serial Number is BCA1-E39D
Directory of C:\traces-general
10/21/2012 04:18 PM 392 myport80.pcapng
10/21/2012 03:52 PM 133,188,364 port80.pcapng
2 File(s) 133,188,756 bytes
0 Dir(s) 206,845,161,472 bytes free
C:\traces-general>

Save Host Information and Work with Existing Trace Files

Why would someone use Tshark instead of dumpcap? There are a few advantages. For example,

Tshark can use the –H <hosts file> option during the capture process. When your

packets are saved to a trace file, the name resolution information contained in the *<hosts file>* is saved with your trace file.

Tshark can also process existing trace files. For example, you can specify an input trace file, apply a

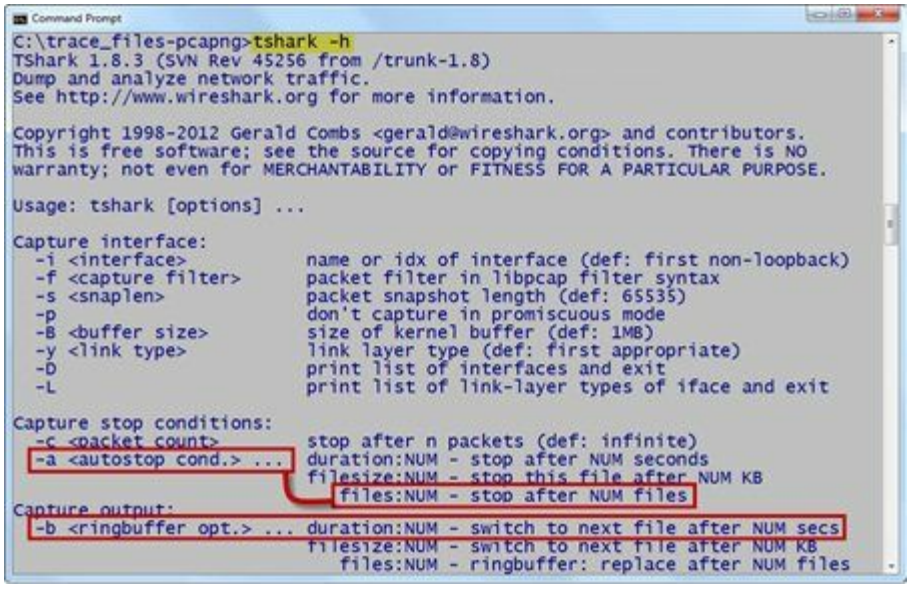
display filter, and save a new file based on the display filter. In Figure 131, we applied an IP address

display filter to *port80.pcapng* and saved a new trace file called *myport80.pcapng*.

Figure 131. Tshark can be run against existing trace files.

Practice with the Tshark parameters listed when you type **tshark –h**.

Command Prompt
C:\trace_files-pcapng>tshark -D
1. \\.\airpcap00 (AirPcap USB wireless capture adapter nr. 00)
2. \\.\airpcap_any (AirPcap Multi-Channel Aggregator)
3. \\.\airpcap01 (AirPcap USB wireless capture adapter nr. 01)
4. \Device\NPF_{6E79FEC0-FF79-4970-96E4-EEFF300A9B9F} (Realtek P
CIe FE Family Controller)
C:\trace_files-pcapng>


Command Prompt
C:\trace_files-pcapng>tshark -h
TShark 1.8.3 (SVN Rev 45256 from /trunk-1.8)
Dump and analyze network traffic.
See http://www.wireshark.org for more information.
Copyright 1998-2012 Gerald Combs <gerald@wireshark.org> and contributors.
This is free software; see the source for copying conditions. There is NO
warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.
Usage: tshark [options] ...
Capture interface:
-i <interface> name or idx of interface (def: first non-loopback)
-f <capture filter> packet filter in libpcap filter syntax
-s <snaplen> packet snapshot length (def: 65535)
-p don't capture in promiscuous mode
-B <buffer size> size of kernel buffer (def: 1MB)
-y <link type> link layer type (def: first appropriate)
-D print list of interfaces and exit
-L print list of link-layer types of iface and exit
Capture stop conditions:
-c <packet count> stop after n packets (def: infinite)
-a <autostop cond.> ... duration:NUM - stop after NUM seconds
filesize:NUM - stop this file after NUM KB
files:NUM - stop after NUM files
Capture output:
-b <ringbuffer opt.> ... duration:NUM - switch to next file after NUM secs
filesize:NUM - switch to next file after NUM KB
files:NUM - ringbuffer: replace after NUM files

Lab 44: Use Tshark to Capture to File Sets with an Autostop

Condition

In this lab, you will get a chance to use Tshark with various parameters. We'll define file set "next

file" parameters and include an autostop condition for unattended capture.

Step 1: Open the **command prompt** (Windows) or a **terminal window** (Linux/Macintosh).

Step 2: Navigate to your trace file directory. Type tshark –D to view the list of available

interfaces. If you aren't certain which interface sees traffic, return to Wireshark and select **Capture |**

Interfaces.

For example, below we compared our interface list in Tshark and Wireshark to see that we don't want

to capture on interface number 3 because there isn't any traffic visible to us on that interface. In our

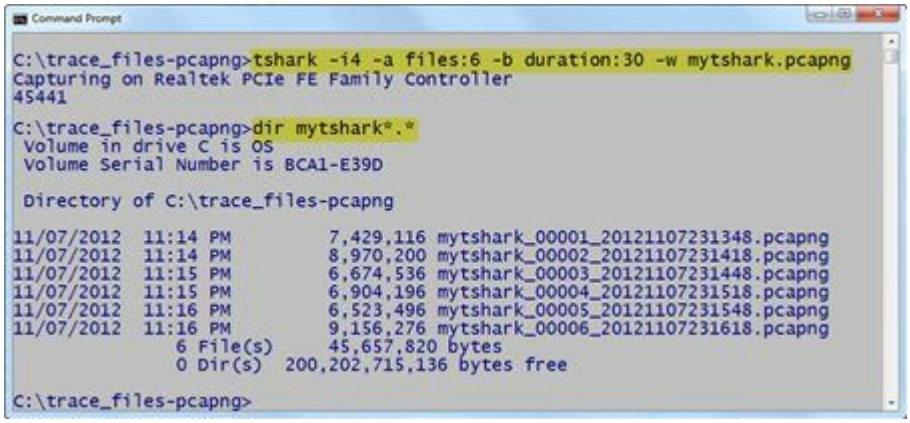
lab example, we will use interface number 4. You should use your most active interface as you follow

along.

Step 3: Once you have determined which interface to use, type tshark –h to view the available

parameters for saving to multiple files and setting an autostop condition.

Look at the **Capture stop conditions** and **Capture output sections**[56]. For this lab, we will switch to the next file after 30 seconds and stop after 6 files have been created.


Command Prompt
C:\trace_files-pcapng>tshark -i4 -a files:6 -b duration:30 -w mytshark.pcapng
Capturing on Realtek PCIe FE Family Controller
45441
C:\trace_files-pcapng>dir mytshark*.*
Volume in drive C is OS
Volume Serial Number is BCA1-E39D
Directory of C:\trace_files-pcapng
11/07/2012 11:14 PM 7,429,116 mytshark_00001_20121107231348.pcapng
11/07/2012 11:14 PM 8,970,200 mytshark_00002_20121107231418.pcapng
11/07/2012 11:15 PM 6,674,536 mytshark_00003_20121107231448.pcapng
11/07/2012 11:15 PM 6,904,196 mytshark_00004_20121107231518.pcapng
11/07/2012 11:16 PM 6,523,496 mytshark_00005_20121107231548.pcapng
11/07/2012 11:16 PM 9,156,276 mytshark_00006_20121107231618.pcapng
6 File(s) 45,657,820 bytes
0 Dir(s) 200,202,715,136 bytes free
C:\trace_files-pcapng>

TIP

We will need to use the following parameters during this capture process:

–i 4 to capture on the 4th interface

–a files:6 to automatically stop capturing after 6 files

–b duration:30 to create the next file after 30 seconds

–w mytshark.pcapng to save to this trace file name

Step 4: At the command line, put it all together by typing tshark –i4 –a files:6 –

b duration:30 –w mytshark.pcapng and press **Enter**.[57]

Open your browser and spend some time browsing *www.wireshark.org* . Return to Wireshark. Be patient if the capture process is still running. It may take longer than the time allocated (3 minutes in

this case) for Wireshark to write all the buffered files.

Step 5: Type dir mytshark*.* to view your files. Notice the timestamp detail that matches your

setting to switch to the next file after 30 seconds.

Spend some time practicing with Tshark. It's best to be comfortable with the parameters and

capabilities of Tshark before someone comes screaming into your office with network complaints[58].

If you use the same parameters and a very long, detailed Tshark string, consider building a

batch file with variables to reduce the chance of typing mistakes. For example, you might

create a batch file called t1.bat that contains the following:

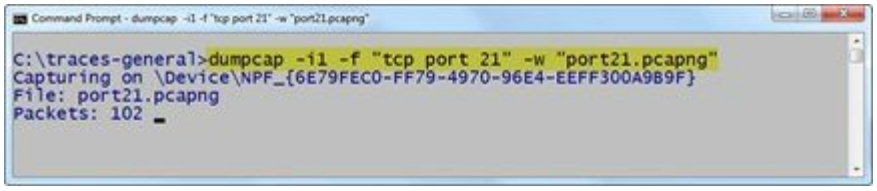
tshark –i%1 –a files:6 –b duration:30 –w %2.pcapng

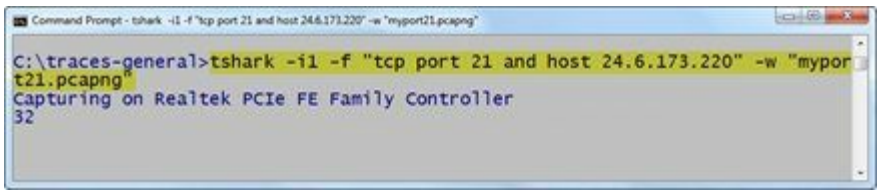
*To use the batch file, type **t1**, the interface number (%1 variable) and file stem (%2 variable),*

*such as **t1 4 test1**. This will capture traffic on interface 4, create six files containing 30*

seconds of traffic each, and name each file beginning with the stem

test1_00000<date/timestamp> through test1_00005<date/timestamp>.


Command Prompt - dumpcap -i1 -f "tcp port 21" -w "port21.pcapng"
C:\traces-general>dumpcap -i1 -f "tcp port 21" -w "port21.pcapng"
Capturing on \Device\NPF_{6E79FEC0-FF79-4970-96E4-EEFF300A9B9F}
File: port21.pcapng
Packets: 102


Command Prompt - tshark -i1 -f "tcp port 21 and host 24.6.173.220" -w "myport21.pcapng"
C:\traces-general>tshark -i1 -f "tcp port 21 and host 24.6.173.220" -w "mypor
t21.pcapng"
Capturing on Realtek PCIe FE Family Controller
32

8.4. Use Capture Filters during Command-

Line Capture

Use capture filters with dumpcap or Tshark when you are capturing on a busy network or you just

want to focus on specific traffic during the capture process,

Both dumpcap and Tshark use the –f option to specify a capture filter using the capture filter (BPF)

format. Use the –w option to set the name of your new trace file. For example, if you are interested in

capturing all traffic running on TCP port 21, enter dumpcap –i1 –f "tcp port 21" –w

port21.pcapng, as shown in Figure 132. You will have to manually stop the capture process

(Ctrl+C).

Figure 132. You will need to manually stop the capture unless you've defined a stop condition.

Capture filtering with Tshark uses the same parameters. For example, in Figure 133 we are capturing

all TCP port 21 traffic to or from 24.6.173.220 to a file called *myport21.pcapng* using the -i, -f, and

–w parameters.

The command would be tshark –i1 –f "tcp port 21 and host 24.6.173.220" –w

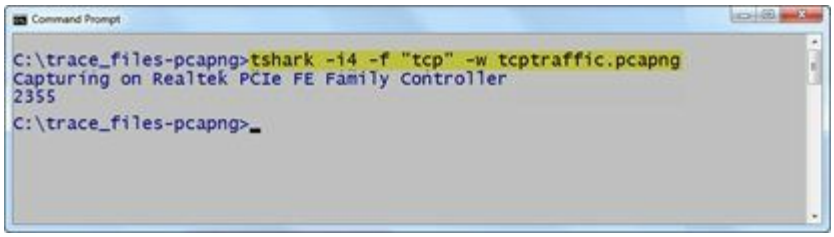
myport21.pcapng. Capture filters can be combined with other parameters.

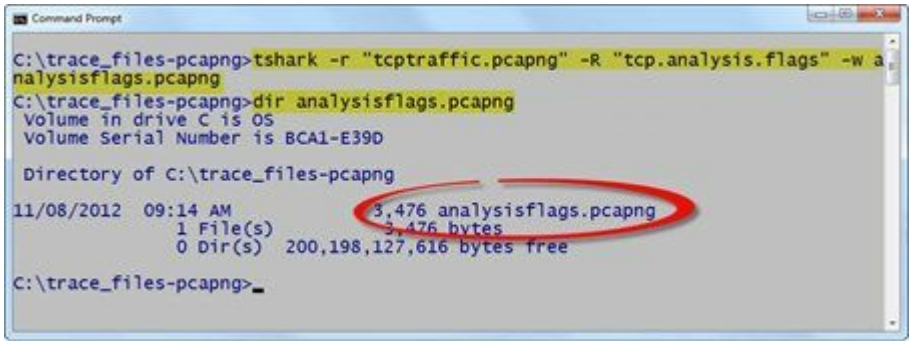
Figure 133. Both Tshark and dumpcap use the BPF capture filter syntax.

Wireshark doesn't recognize capture filter names, such as NotMyMAC (created in Lab 13).

Use the capture filter string and enclose the filter string in quotes. Quotes are necessary if

you have spaces in your filter, as we see in Figure 133.





8.5. Use Display Filters during Command-

Line Capture

Display filters have many more options than capture filters. When capturing at command line,

however, there is a display filter limitation that you must be aware of. You can use display filters with

the –R parameter during a live capture, but you can cannot save the trace file while using that

parameter.

Because of this limitation, consider capturing all traffic, save the packets to a file (or file sets if

necessary), apply display filters to the saved trace file, and save the subset to a new trace file.

If you want to capture only packets that match the tcp.analysis.flags filter, for example,

first use a capture filter to capture all TCP traffic and save that traffic to a file. In Figure 134, we are

capturing and saving TCP traffic to a file called *tcptraffic.pcapng*. That is the first step.

Figure 134. Begin with a capture filter and save the packets to a file.

The second step is to use the –r parameter to read the trace file you created, the ndash;R parameter

to specify a display filter, and the –w parameter to save a new trace file, as shown in Figure 135.

Figure 135. Use the –R parameter to apply display filters and save a subset of the packets.

In Lab 45 you will use the –R parameter to extract HTTP GET requests from a trace file and save

these GET requests in a new trace file.

Command Prompt
C:\trace_files-pcapng>dir http-espn101.pcapng
Volume in drive C is OS
Volume Serial Number is BCA1-E39D
Directory of C:\trace_files-pcapng
10/30/2012 04:02 PM 4,698,292 http-espn101.pcapng
1 File(s) 4,698,292 bytes
0 Dir(s) 199,935,361,024 bytes free
C:\trace_files-pcapng>tshark -r "http-espn101.pcapng" -R "http.request.method=="GET"" -w "httpGETs.pcapng"
C:\trace_files-pcapng>dir httpGETs.pcapng
Volume in drive C is OS
Volume Serial Number is BCA1-E39D
Directory of C:\trace_files-pcapng
11/08/2012 10:02 AM 99,560 httpGETs.pcapng
1 File(s) 99,560 bytes
0 Dir(s) 199,935,225,856 bytes free
C:\trace_files-pcapng>

TIP

Lab 45: Use Tshark to Extract HTTP GET Requests

In this lab you will use the –r parameter to read a trace file and then apply a display filter with the –R

parameter. Finally you will save a trace file that contains only the HTTP GET requests.

Step 1: Open the **command prompt** (Windows) or a **terminal window** (Linux/Macintosh).

Step 2: Navigate to your trace file directory.

Type tshark –r "http-espn101.pcapng" –R "http.request.method=="GET"" –

w "httpGETs.pcapng" and press **Enter**.

That's it. Now you can open your trace file in Wireshark for further analysis.

The best way to use display filters and Tshark is to capture and save all the traffic using

Tshark and then open the trace file in Wireshark to apply display filters and perform analysis

tasks.

8.6. Use Tshark to Export Specific Field

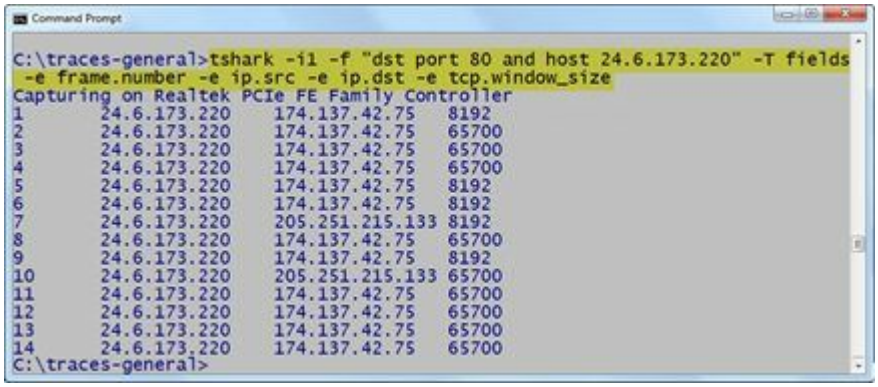
Values and Statistics from a Trace File

Sometimes you may want to get a general feel for the traffic with or without capturing the traffic. This

is where Tshark is the only command-line tool to use.

Run tshark –h to view the available options. Field export options and export statistics are listed

under the Output area.



Export Field Values

You must use –T fields first. Then you can list the fields you are interested in after the –e parameter.

You can combine these parameters with display filters as needed. For example, in Figure 136 we typed

tshark –i1 –f "dst port 80 and host 24.6.173.220" –T fields –

e frame.number –e ip.src –e ip.dst –e tcp.window_size to capture traffic

to/from 24.6.173.220 to port 80 on interface 1 and display the frame number, source and destination IP

addresses, and TCP window size value.

You will need to manually stop the capture process using **Ctrl+C**. If you can't manually stop the

process, consider adding a stop condition to your Tshark command.

Figure 136. You will need to manually stop the capture process

Use the –E parameter to add options to make the exported information easier to read. For example,

add –E header=y to add a field header.

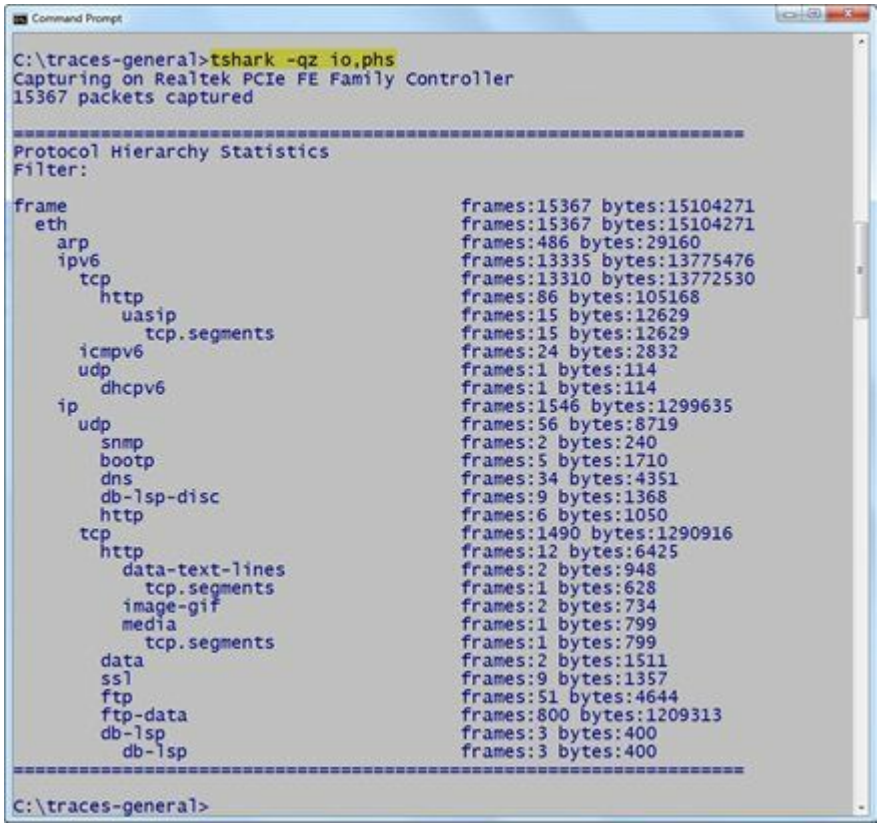
To analyze the information in a spreadsheet use the –E separator=, to set up the exported

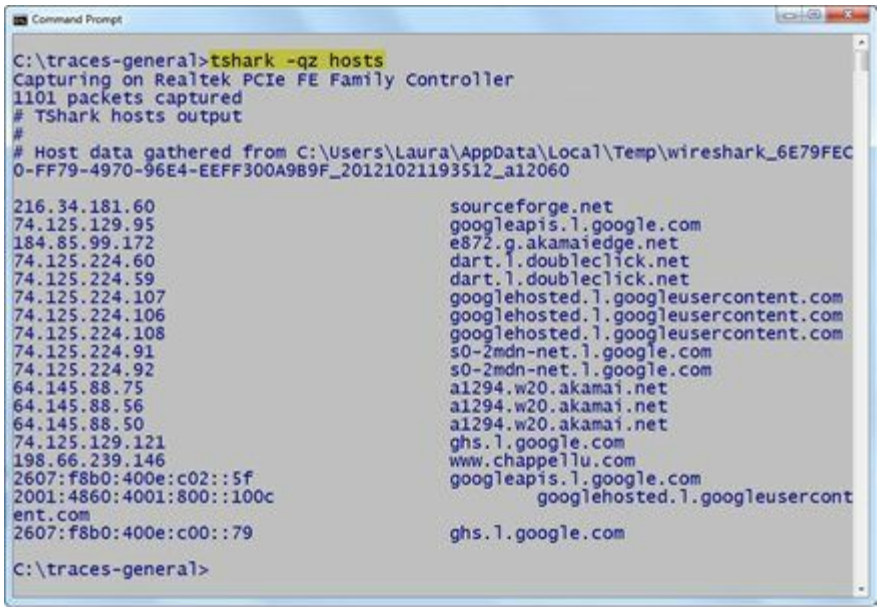
information in comma-separated format.

You can use > stats.txt at the end of your command to save this information to a file named

stats.txt.

Again, use tshark –h to view all available options.





Export Traffic Statistics

Use the –z parameter to view numerous statistics about your traffic. You might also consider using

the –q parameter to quiet down Tshark from displaying each frame on the screen. For example, in

Figure 137 we ran tshark –qz io,phs to display the Protocol Hierarchy Statistics (phs).

Figure 137. We can see the various protocols and applications in use without capturing traffic.

If you want to export any of the statistics to a text file, simply redirect the results to a file, as

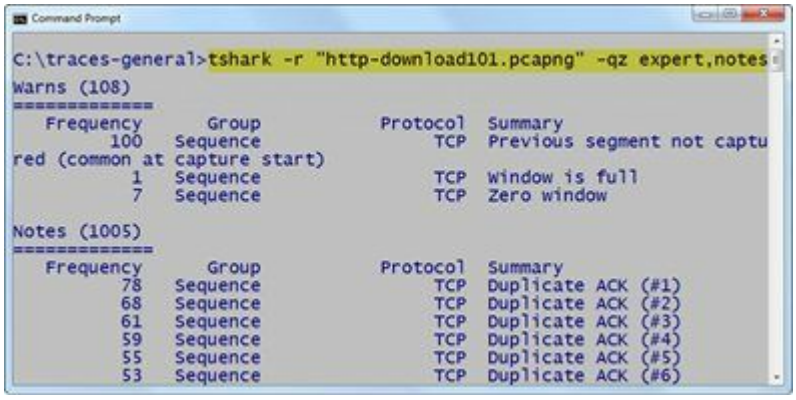
mentioned earlier. For example, tshark –qz io,phs > stats.txt. As you continue to gather

statistics, use >> instead of > to append additional information to the existing text file.

One of the most interesting statistics is the list of hosts that are communicating on the network. In

Figure 138, we typed tshark –qz hosts to extract the list of active hosts.

Figure 138. It is easy to build a list of active hosts seen on the network using tshark –qz hosts.


Command Prompt
C:\traces-general>tshark -r "http-download101.pcapng" -qz expert,notes
Warns (108)
Frequency Group Protocol Summary
100 Sequence TCP Previous segment not captured (common at capture start)
1 Sequence TCP Window is full
7 Sequence TCP Zero window
Notes (1005)
Frequency Group Protocol Summary
78 Sequence TCP Duplicate ACK (#1)
68 Sequence TCP Duplicate ACK (#2)
61 Sequence TCP Duplicate ACK (#3)
59 Sequence TCP Duplicate ACK (#4)
55 Sequence TCP Duplicate ACK (#5)
53 Sequence TCP Duplicate ACK (#6)

If you want to extract the Expert warnings, notes, and errors from an existing trace file, use the –r

parameter. For example, in Figure 139 we typed tshark –r "http–download101.pcapng"

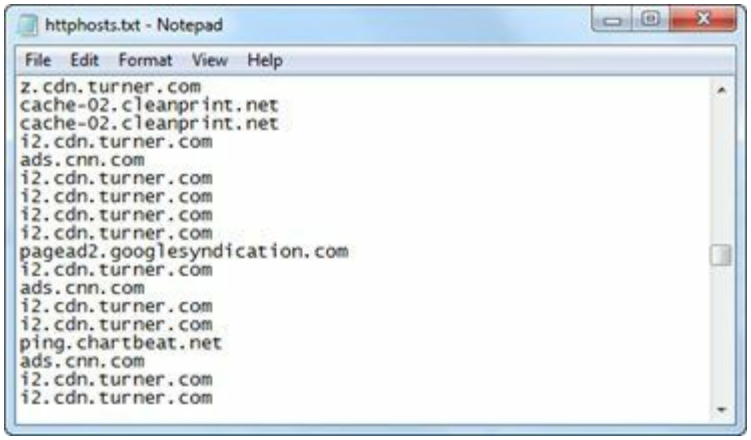
–qz expert,notes to see we have packet loss and a zero window condition in the trace file. If

you are only interested in seeing Expert errors and warnings, use –qz expert,warn.

Figure 139. Pulling the expert warnings, we can see some indications of segments not captured. [http–download101.pcapng]

See www.wireshark.org/docs/man-pages/tshark.html for more details on the –z parameter.

Command Prompt
C:\trace_files-pcapng>tshark -i4 -R "http.host" -T fields -e http.host > httphosts.txt
Capturing on Realtek PCIe FE Family Controller
304 packets captured
C:\trace_files-pcapng>



Export HTTP Host Field Values

You can easily use Tshark to capture all the HTTP Host field values currently seen on the network and

save that information to a text file. To do this, include a display filter for packets that contain the

http.host field. In addition, define *http.host* as the exported field name and export the

information to a text file. In Figure 140, we saved the HTTP Host field values to a file called

httphosts.txt.

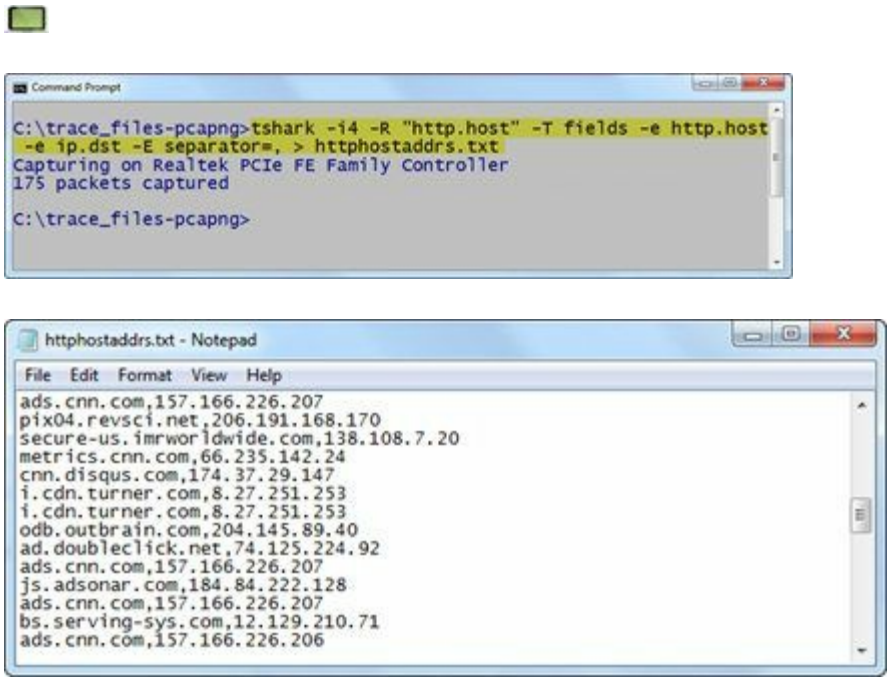
Figure 140. We used a display filter and field value of http.host to create a host list file.

The resulting text file only includes the HTTP Host field values, as shown in Figure 141. We could

add another field parameter to save the destination IP address (*ip.dst*), as well. We will do this in

Lab 46.

Figure 141. You can create a list of all the HTTP Host field values seen in the trace file.



Lab 46: Use Tshark to Extract HTTP Host Names and IP

Addresses

In this lab we will use a combination of display filters and field names to create a file that contains

both the IP addresses and host names of HTTP servers contacted on the network.

Step 1: Open the **command prompt** (Windows) or a **terminal window** (Linux/Macintosh).

Step 2: Navigate to the directory in which you want to save your new HTTP host name/address file.

Type **tshark –i4 –R "http.host && ip" –T fields –e http.host –e ip.dst**

–E separator=, > httphostaddrs.txt and press **Enter**.

Step 3: Toggle to your browser and visit various web sites. After a few minutes, toggle back to your

command prompt or terminal window and manually stop the capture process (**Ctrl+C** on windows, for

example).

Wireshark displays the captured packet count, which is the number of host names and IP addresses

you have in your text file.

Step 4: Open and examine your **httphostaddrs.txt** file.

Practice working with the fields and filters to extract just the information in which you are interested.

Consider creating a batch file or script to run Tshark commands you use often.

8.7. Continue Learning about Wireshark and

Network Analysis

By this point you've covered the most important Wireshark skills and network analysis functions.

You've run through 46 labs and you're about to finish Challenge 8. Once that is complete, what's next?

Here are some recommendations for continuing your education in network analysis:

Visit *www.wiresharkbook.com* and check out the supplements for this book and other books listed on that site.

Visit *www.wireshark.org* to sign up for the Wireshark-Announce mailing list to receive notifications when a new Wireshark version is available for download.

Sign up for the newsletter at *www.chappellU.com* to participate in free online Wireshark events.

Practice capturing your own traffic to become accustomed to the type of traffic that is generated

when you browse web sites, send email, or login to the company server.

Continue customizing Wireshark by adding new profiles and new display filters, coloring rules,

and Filter Expression buttons.

Share your customized settings with other IT team members to create a master profile that

improves your team's network analysis efficiency.

As you've read on the title page for each chapter, there are many benefits to becoming proficient at

network analysis. Now is the time to start delving into your network traffic to spot problems and

detect those network anomalies faster.

Chapter 8 Challenge

Use *challenge101-8.pcapng* and the command-line tool techniques covered in this chapter to answer

these Challenge questions. The answer key is located in Appendix A.

Question 8-1.

What Tshark parameter should you use to list active interfaces on your Wireshark system?

Question 8-2.

Using Tshark to extract protocol hierarchy information, how many UDP frames are in *challenge101-*

8.pcapng?

Question 8-3.

Use Tshark to export all DNS packets from *challenge101-8.pcapng* to a new trace file called

ch8dns.pcapng. How many packets were exported?

Appendix A: Challenge Answers

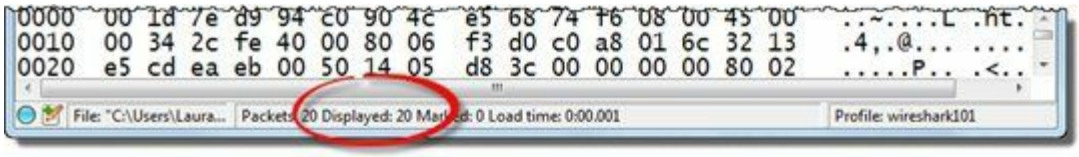
"Now that you know, share. Share the knowledge with others. Take five minutes to teach someone

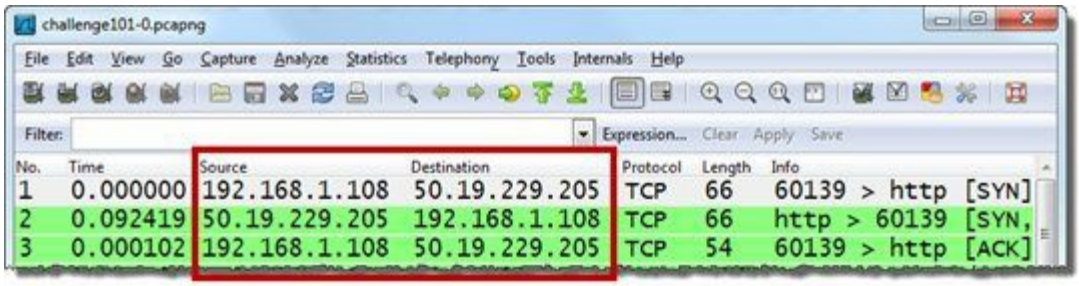
something cool that you learned that could end their networking nightmare. I will never forget the first

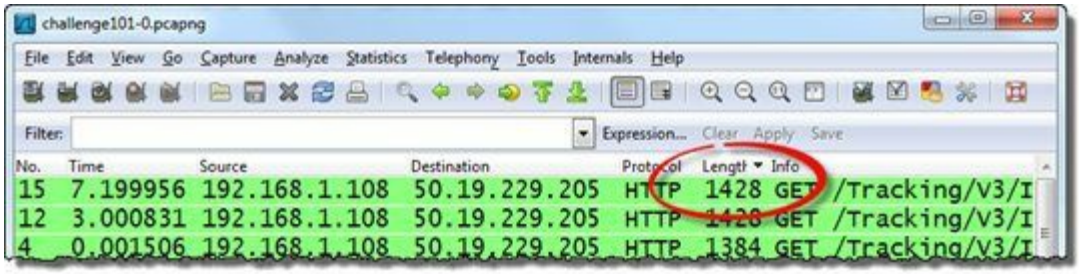
person that introduced me to Wireshark and I am forever grateful. Be that first for someone."

Jennifer Keels

CNP-S, CEH, Network Engineer




challenge101-0.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
1 0.000000 192.168.1.108 50.19.229.205 TCP 66 60139 > http [SYN]
2 0.092419 50.19.229.205 192.168.1.108 TCP 66 http > 60139 [SYN,
3 0.000102 192.168.1.108 50.19.229.205 TCP 54 60139 > http [ACK]


challenge101-0.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
15 7.199956 192.168.1.108 50.19.229.205 HTTP 1428 GET /Tracking/V3/I
12 3.000831 192.168.1.108 50.19.229.205 HTTP 1428 GET /Tracking/V3/I
4 0.001506 192.168.1.108 50.19.229.205 HTTP 1384 GET /Tracking/V3/I

Chapter 0 Challenge Answers

Answer 0-1.

The Status Bar indicates this trace file contains 20 frames.

Answer 0-2.

The **Source** and **Destination** columns indicate this TCP connection is between 192.168.1.108 and

50.19.229.205.

Answer 0-3.

Frame 4 is an HTTP GET request.

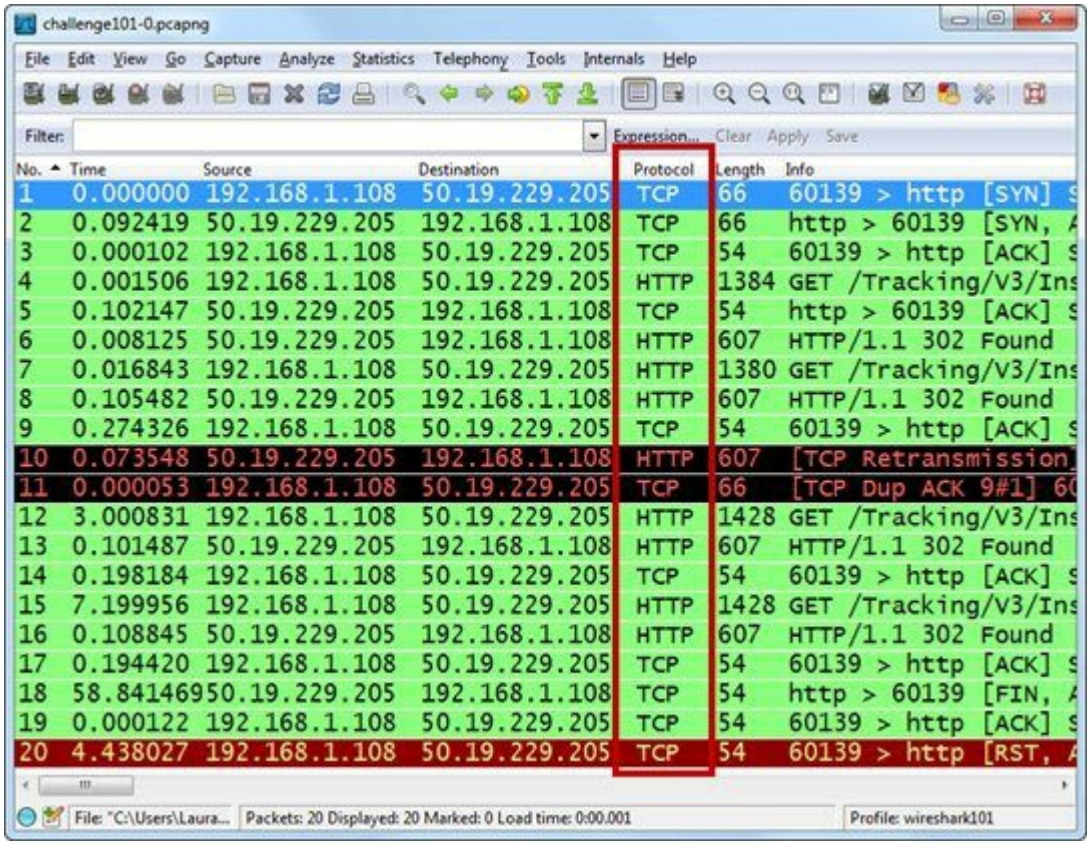
Answer 0-4.

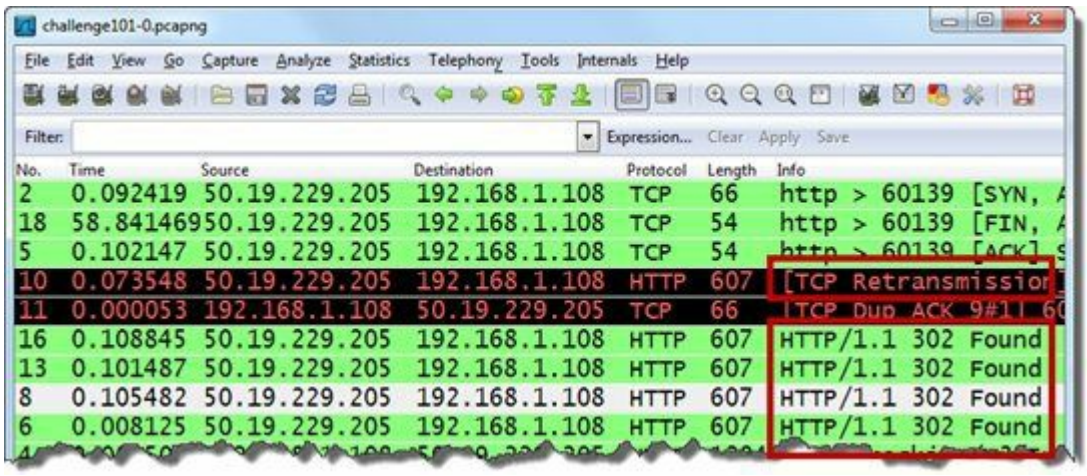
Sorting on the **Length** column (or even just scrolling through the file and looking at the **Length**

column) indicates the largest frame is 1,428 bytes.

Answer 0-5.

Wireshark displays only HTTP and TCP in the **Protocol** column.





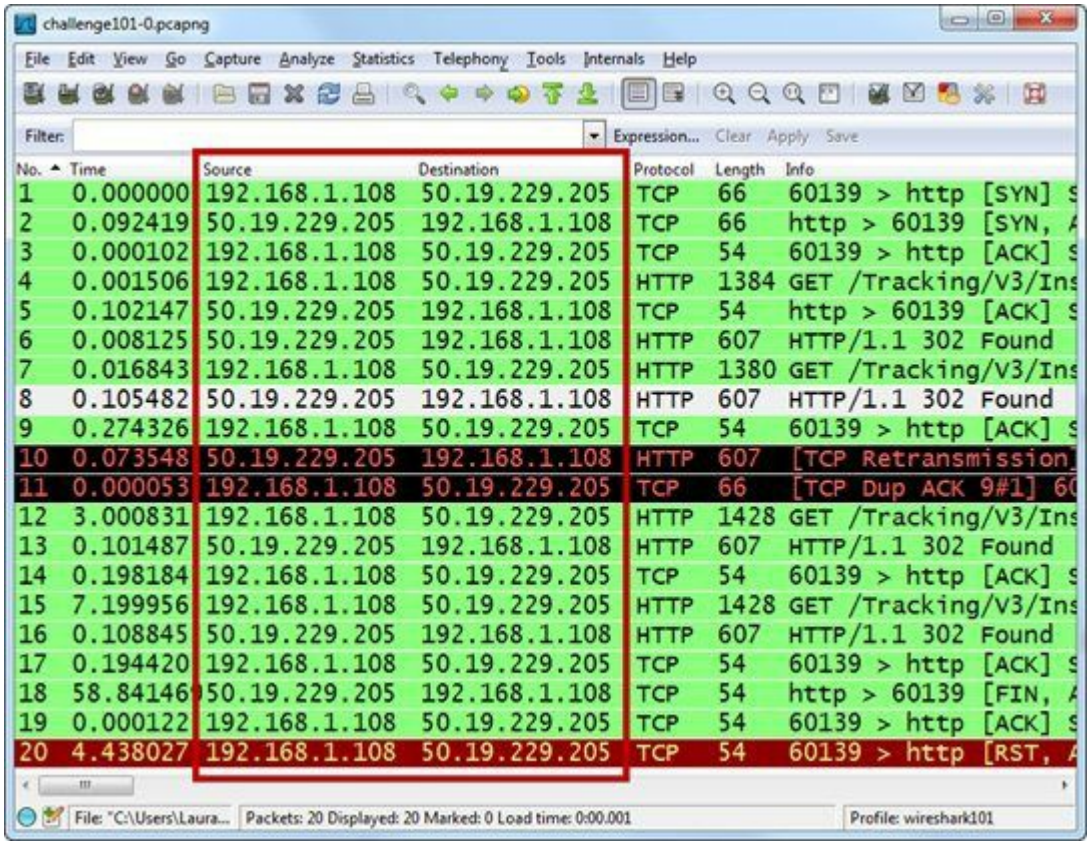
Answer 0-6.

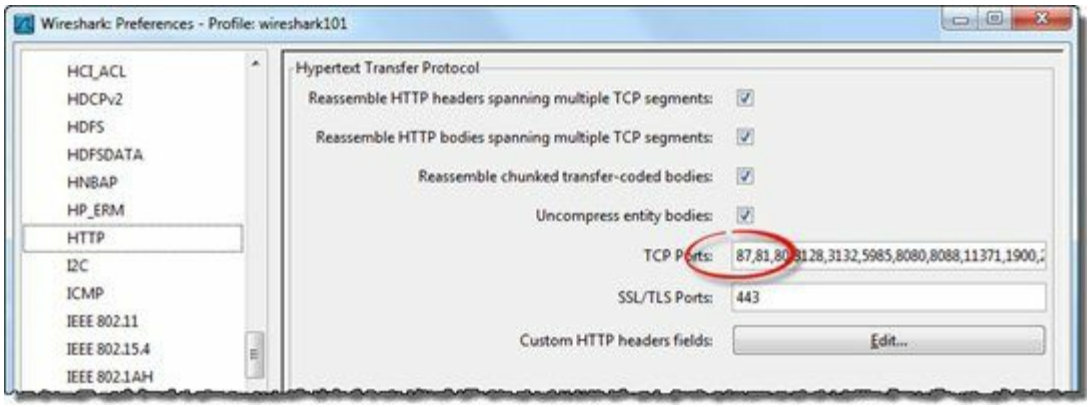
The HTTP server sends 302 Found responses (frames 6, 8, 10, 13, and 16).

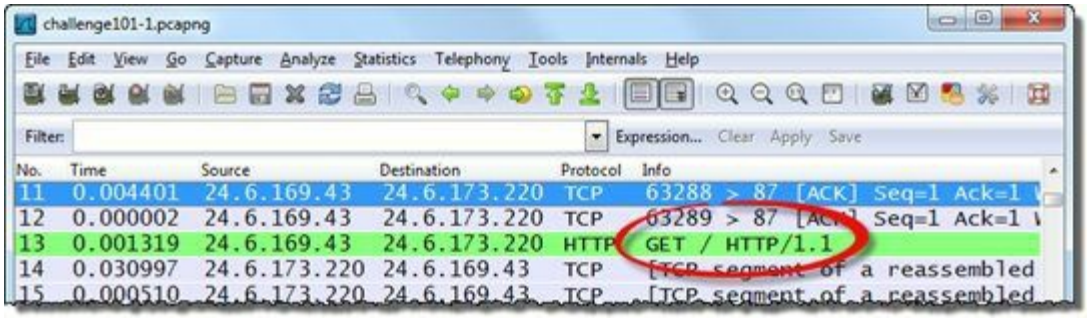
Answer 0-7.

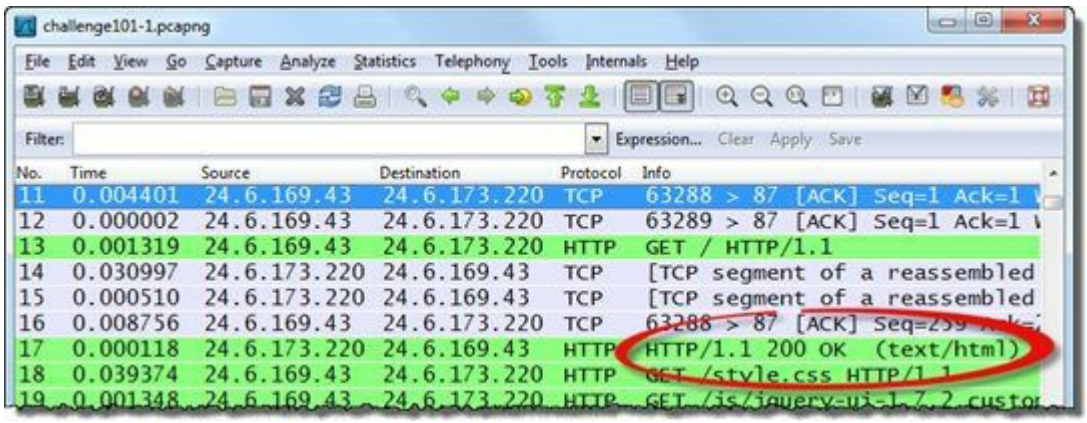
There are no IPv6 packets in this trace file—the **Source** and **Destination** columns only display IPv4

addresses.


challenge101-0.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
1 0.000000 192.168.1.108 50.19.229.205 TCP 66 60139 > http [SYN]
2 0.092419 50.19.229.205 192.168.1.108 TCP 66 http > 60139 [SYN,
3 0.000102 192.168.1.108 50.19.229.205 TCP 54 60139 > http [ACK]
4 0.001506 192.168.1.108 50.19.229.205 HTTP 1384 GET /Tracking/V3/Ins
5 0.102147 50.19.229.205 192.168.1.108 TCP 54 http > 60139 [ACK]
6 0.008125 50.19.229.205 192.168.1.108 HTTP 607 HTTP/1.1 302 Found
7 0.016843 192.168.1.108 50.19.229.205 HTTP 1380 GET /Tracking/V3/Ins
8 0.105482 50.19.229.205 192.168.1.108 HTTP 607 HTTP/1.1 302 Found
9 0.274326 192.168.1.108 50.19.229.205 TCP 54 60139 > http [ACK]
10 0.073548 50.19.229.205 192.168.1.108 HTTP 607 [TCP Retransmission
11 0.000053 192.168.1.108 50.19.229.205 TCP 66 [TCP Dup ACK 9#1]
12 3.000831 192.168.1.108 50.19.229.205 HTTP 1428 GET /Tracking/V3/Ins
13 0.101487 50.19.229.205 192.168.1.108 HTTP 607 HTTP/1.1 302 Found
14 0.198184 192.168.1.108 50.19.229.205 TCP 54 60139 > http [ACK]
15 7.199956 192.168.1.108 50.19.229.205 HTTP 1428 GET /Tracking/V3/Ins
16 0.108845 50.19.229.205 192.168.1.108 HTTP 607 HTTP/1.1 302 Found
17 0.194420 192.168.1.108 50.19.229.205 TCP 54 60139 > http [ACK]
18 58.84146 50.19.229.205 192.168.1.108 TCP 54 http > 60139 [FIN,
19 0.000122 192.168.1.108 50.19.229.205 TCP 54 60139 > http [ACK]
20 4.438027 192.168.1.108 50.19.229.205 TCP 54 60139 > http [RST,
File: "C:\Users\Laura... Packets: 20 Displayed: 20 Marked: 0 Load time: 0:00.001
Profile: wireshark101


Wireshark: Preferences - Profile: wireshark101
HCI_ACL
HDCPv2
HDFS
HDFSDATA
HNBAP
HP_ERM
HTTP
I2C
ICMP
IEEE 802.11
IEEE 802.15.4
IEEE 802.1AH
Hypertext Transfer Protocol
Reassemble HTTP headers spanning multiple TCP segments:
Reassemble HTTP bodies spanning multiple TCP segments:
Reassemble chunked transfer-coded bodies:
Uncompress entity bodies:
TCP Ports:
SSL/TLS Ports: 443
Custom HTTP headers fields:
Edit...


challenge101-1.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Info
11 0.004401 24.6.169.43 24.6.173.220 TCP 63288 > 87 [ACK] Seq=1 Ack=1
12 0.000002 24.6.169.43 24.6.173.220 TCP 63289 > 87 [ACK] Seq=1 Ack=1
13 0.001319 24.6.169.43 24.6.173.220 HTTP GET / HTTP/1.1
14 0.030997 24.6.173.220 24.6.169.43 TCP [TCP segment of a reassembled
15 0.000510 24.6.173.220 24.6.169.43 TCP [TCP segment of a reassembled


challenge101-1.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Info
11 0.004401 24.6.169.43 24.6.173.220 TCP 63288 > 87 [ACK] Seq=1 Ack=1
12 0.000002 24.6.169.43 24.6.173.220 TCP 63289 > 87 [ACK] Seq=1 Ack=1
13 0.001319 24.6.169.43 24.6.173.220 HTTP GET / HTTP/1.1
14 0.030997 24.6.173.220 24.6.169.43 TCP [TCP segment of a reassembled
15 0.000510 24.6.173.220 24.6.169.43 TCP [TCP segment of a reassembled
16 0.008756 24.6.169.43 24.6.173.220 TCP 63288 > 87 [ACK] Seq=259
17 0.000118 24.6.173.220 24.6.169.43 HTTP HTTP/1.1 200 OK (text/html)
18 0.039374 24.6.169.43 24.6.173.220 HTTP GET /style.css HTTP/1.1
19 0.001348 24.6.169.43 24.6.173.220 HTTP GET /js/jquery-ui-1.7.2.custo

Chapter 1 Challenge Answers

Answer 1-1.

In order to see the default page ("/") request, you must add port 87 in the HTTP preference setting

(**Edit | Preferences | (+) Protocols | HTTP**).

You may need to click the reload button

on the main toolbar to apply your new setting to the trace

file.

We can now see frame 13 is the GET request for the default page.

Answer 1-2.

In frame 17, the server responds with 200 OK.

Answer 1-3.

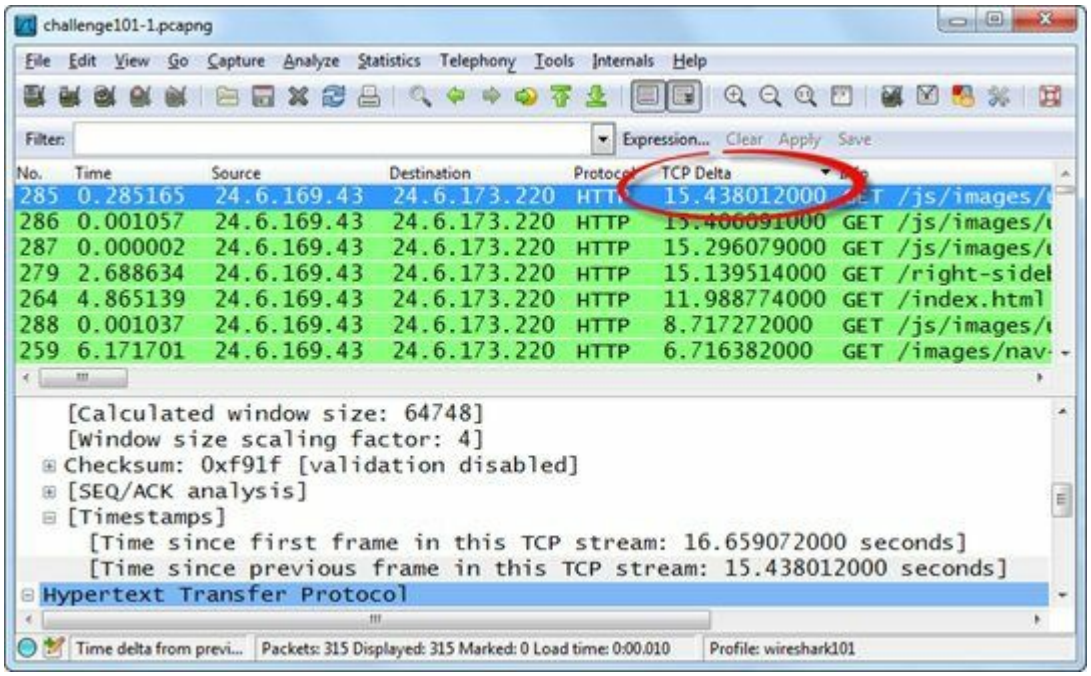
In order to view the TCP delta time, we must enable the *Calculate conversation timestamps* TCP

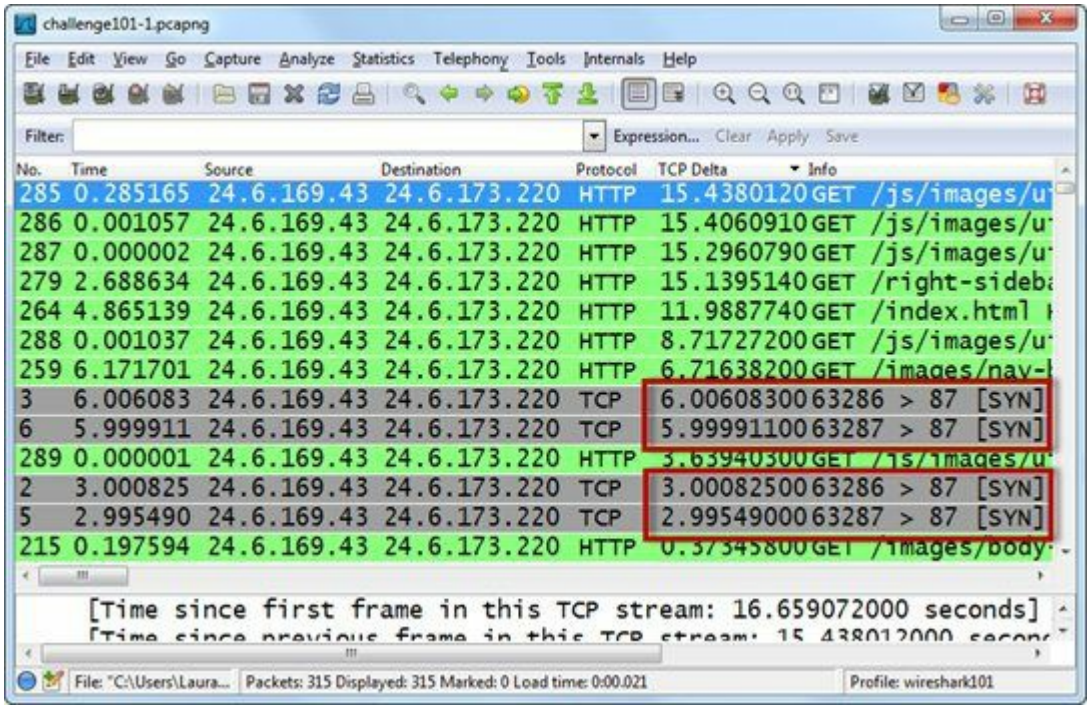
preference (**Edit | Preferences | (+) Protocols | TCP**). Then we can right-click on the new **"Time**

since previous frame in this TCP stream" line at the end of the TCP header, select **Apply as**

Column, and click twice on the new column's heading to sort from high to low. Frame 285 contains

the largest TCP delta time, 15.438012000 seconds.


challenge101-1.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol TCP Delta
285 0.285165 24.6.169.43 24.6.173.220 HTTP 15.438012000 GET /js/images/
286 0.001057 24.6.169.43 24.6.173.220 HTTP 15.406091000 GET /js/images/
287 0.000002 24.6.169.43 24.6.173.220 HTTP 15.296079000 GET /js/images/
279 2.688634 24.6.169.43 24.6.173.220 HTTP 15.139514000 GET /right-sidebar
264 4.865139 24.6.169.43 24.6.173.220 HTTP 11.988774000 GET /index.html
288 0.001037 24.6.169.43 24.6.173.220 HTTP 8.717272000 GET /js/images/
259 6.171701 24.6.169.43 24.6.173.220 HTTP 6.716382000 GET /images/nav-
[Calculated window size: 64748]
[Window size scaling factor: 4]
Checksum: 0xf91f [validation disabled]
[SEQ/ACK analysis]
[Timestamps]
[Time since first frame in this TCP stream: 16.659072000 seconds]
[Time since previous frame in this TCP stream: 15.438012000 seconds]
Hypertext Transfer Protocol
Time delta from previ...
Packets: 315 Displayed: 315 Marked: 0 Load time: 0:00.010
Profile: wireshark101



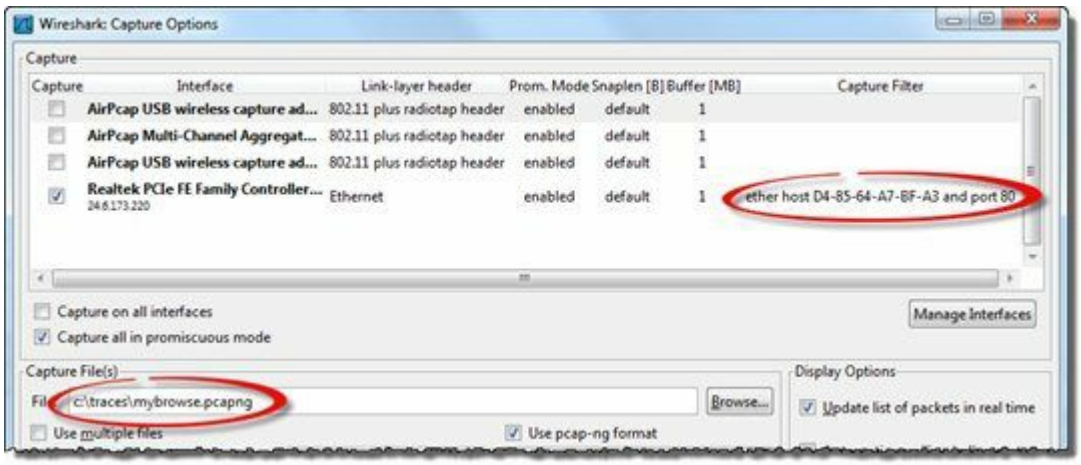
Answer 1-4.

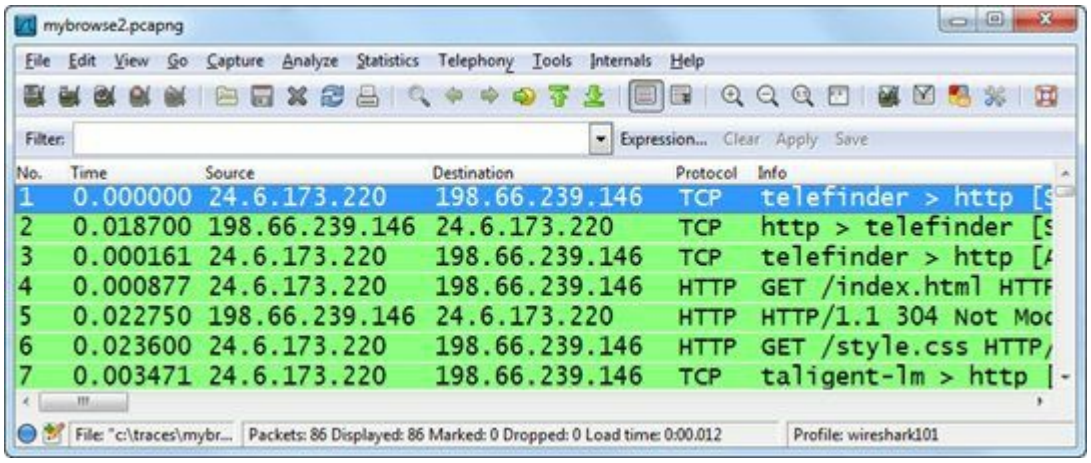
Based on the **TCP Delta** column sorted in Question 1-3, we can look in the **Info** column and **TCP**

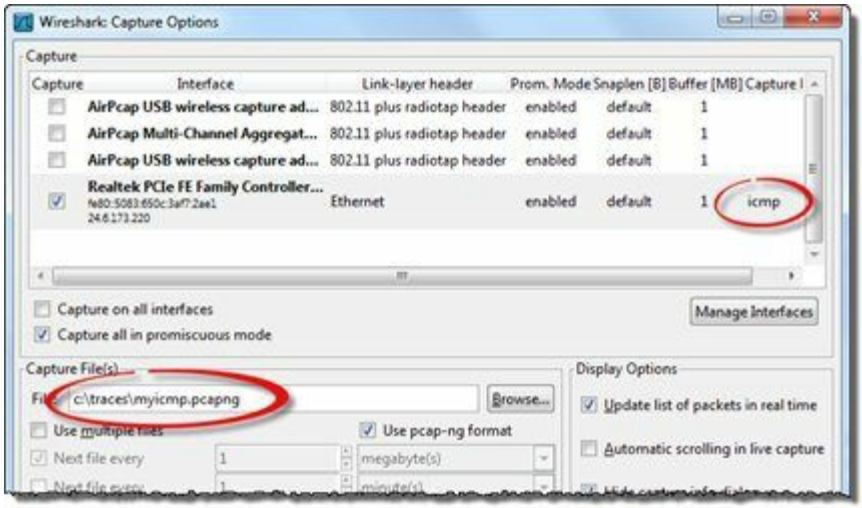
Delta column to see how many SYN packets have a value greater than 1 second. Four SYN packets

arrived after at least a 1 second delay (frames 3, 6, 2, and 5 in that order). This is a sign that there are

problems connecting to a TCP peer.


Wireshark: Capture Options
Capture
Capture Interface Link-layer header Prom. Mode Snaplen [B] Buffer [MB] Capture Filter
AirPcap USB wireless capture ad... 802.11 plus radiotap header enabled default 1
AirPcap Multi-Channel Aggregat... 802.11 plus radiotap header enabled default 1
AirPcap USB wireless capture ad... 802.11 plus radiotap header enabled default 1
Realtek PCIe FE Family Controller... Ethernet enabled default 1 ether host D4-85-64-A7-BF-A3 and port 80
24.6.173.220
Capture on all interfaces
Capture all in promiscuous mode
Manage Interfaces
Capture File(s)
File: c:\traces\mybrowse.pcapng
Browse...
Use multiple files
Use pcap-ng format
Display Options
Update list of packets in real time


mybrowse2.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Info
1 0.000000 24.6.173.220 198.66.239.146 TCP telefinder > http [S
2 0.018700 198.66.239.146 24.6.173.220 TCP http > telefinder [S
3 0.000161 24.6.173.220 198.66.239.146 TCP telefinder > http [A
4 0.000877 24.6.173.220 198.66.239.146 HTTP GET /index.html HTTP
5 0.022750 198.66.239.146 24.6.173.220 HTTP HTTP/1.1 304 Not Mod
6 0.023600 24.6.173.220 198.66.239.146 HTTP GET /style.css HTTP/
7 0.003471 24.6.173.220 198.66.239.146 TCP taligent-lm > http [
File: "c:\traces\mybr... Packets: 86 Displayed: 86 Marked: 0 Dropped: 0 Load time: 0:00.012
Profile: wireshark101


Wireshark: Capture Options
Capture
Capture Interface Link-layer header Prom. Mode Snaplen [B] Buffer [MB] Capture I
AirPcap USB wireless capture ad... 802.11 plus radiotap header enabled default 1
AirPcap Multi-Channel Aggregat... 802.11 plus radiotap header enabled default 1
AirPcap USB wireless capture ad... 802.11 plus radiotap header enabled default 1
Realtek PCIe FE Family Controller... Ethernet enabled default 1 icmp
fe80:5083:650c:3af7:2ae1
24.6.173.220
Capture on all interfaces
Capture all in promiscuous mode
Manage Interfaces
Capture File(s)
File: c:\traces\myicmp.pcapng
Browse...
Use multiple files
Use pcap-ng format
Next file every 1 megabyte(s)
Display Options
Update list of packets in real time
Automatic scrolling in live capture

Chapter 2 Challenge Answers

Answer 2-1.

First you configured Wireshark to automatically capture only your traffic to and from port 80 and save

the traffic to a file named *mybrowse.pcapng*. An example Capture Options window is shown below.

No ICMP traffic was captured.

Answer 2-2.

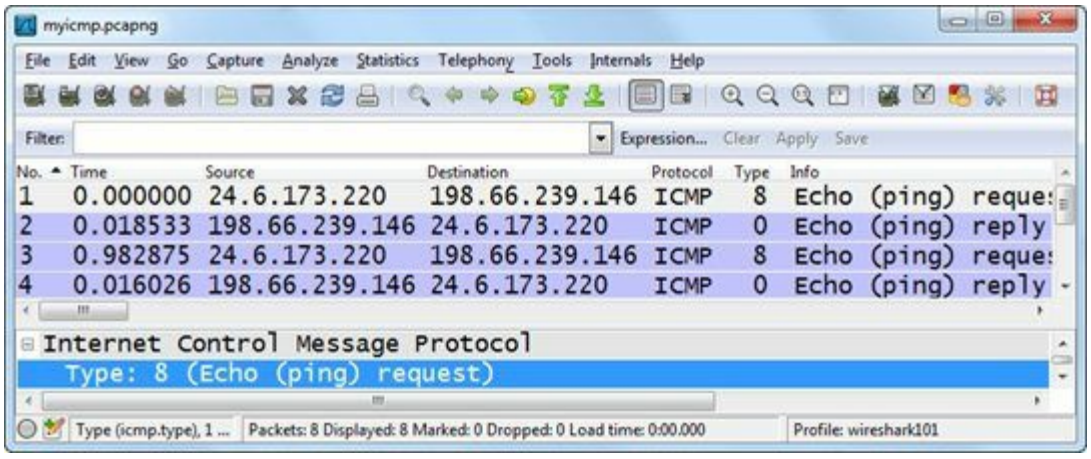
After pinging and browsing to *www.chappellU.com*, you should only have captured your traffic to or

from port 80. The **Protocol** column will only list TCP and HTTP traffic.

Answer 2-3.

Now you should have configured Wireshark to automatically capture and save all your ICMP traffic to

a file called *myicmp.pcapng*. An example Capture Options window is shown below.


myicmp.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Type Info
1 0.000000 24.6.173.220 198.66.239.146 ICMP 8 Echo (ping) reque
2 0.018533 198.66.239.146 24.6.173.220 ICMP 0 Echo (ping) reply
3 0.982875 24.6.173.220 198.66.239.146 ICMP 8 Echo (ping) reque
4 0.016026 198.66.239.146 24.6.173.220 ICMP 0 Echo (ping) reply
Internet Control Message Protocol
Type: 8 (Echo (ping) request)
Type (icmp.type), 1 ...
Packets: 8 Displayed: 8 Marked: 0 Dropped: 0 Load time: 0:00.000
Profile: wireshark101

After you pinged and browsed to *www.chappellU.com* again, you should have seen that the trace file

only contains ICMP traffic based on your capture filter. How many ICMP packets you captured

depends on the amount of ICMP traffic generated by your ping application and any background ICMP

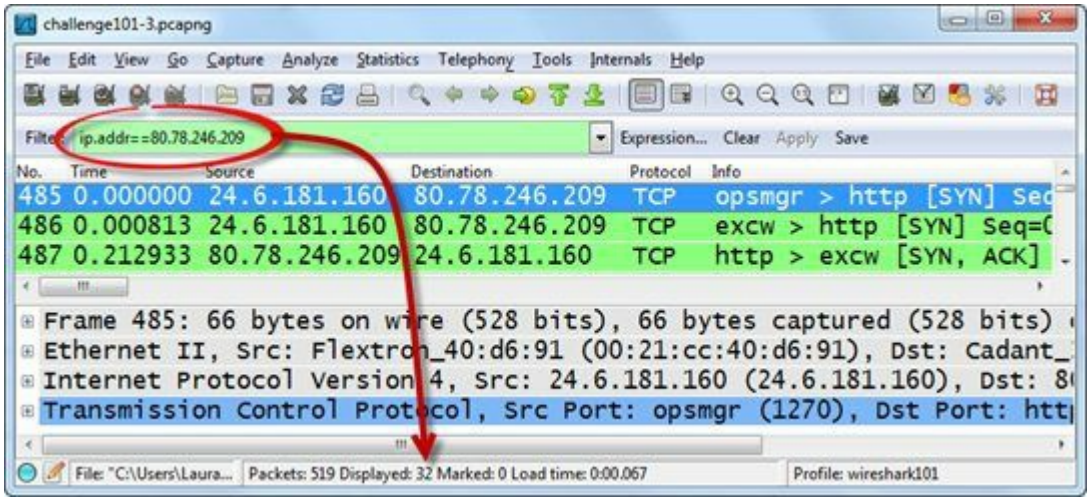
traffic generated during your capture process.

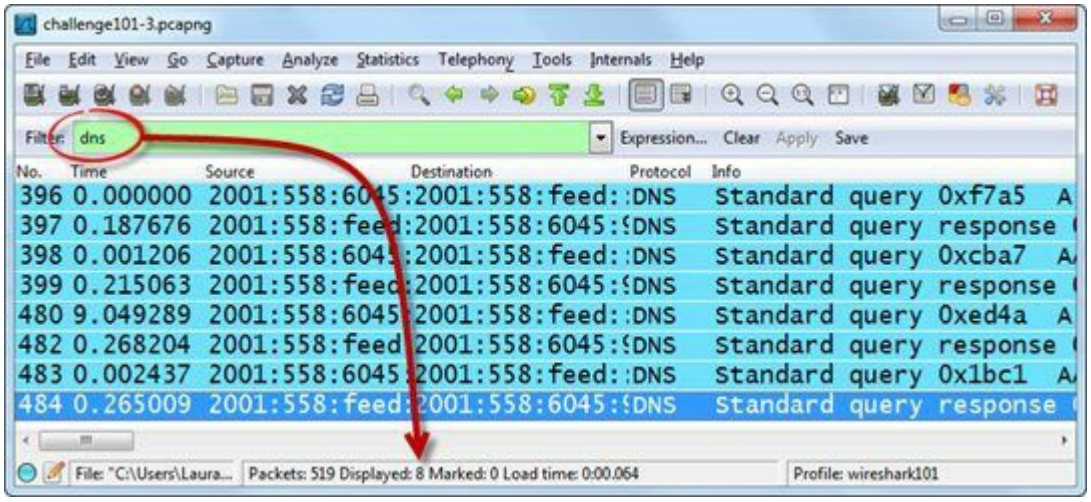
Answer 2-4.

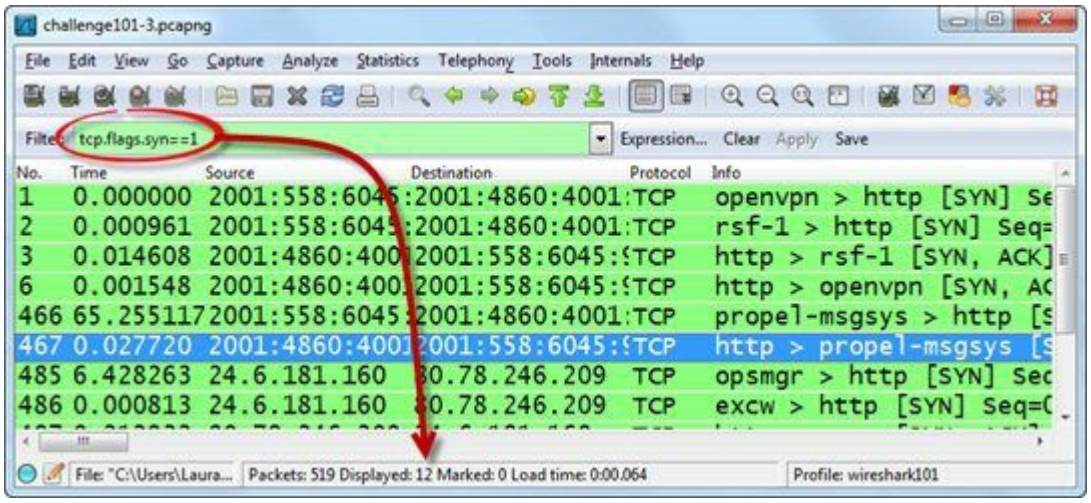
If you look inside the ICMP portion of the packets, you should see Type 8/Code 0 (Echo request) and

Type 0/Code 0 (Echo reply). In the image below we right–clicked on the ICMP Type field and selected

Apply as Column.


challenge101-3.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: ip.addr==80.78.246.209
Expression... Clear Apply Save
No. Time Source Destination Protocol Info
485 0.000000 24.6.181.160 80.78.246.209 TCP opsmgr > http [SYN] Seq
486 0.000813 24.6.181.160 80.78.246.209 TCP excw > http [SYN] Seq=0
487 0.212933 80.78.246.209 24.6.181.160 TCP http > excw [SYN, ACK]
Frame 485: 66 bytes on wire (528 bits), 66 bytes captured (528 bits)
Ethernet II, Src: Flextron_40:d6:91 (00:21:cc:40:d6:91), Dst: Cadant_
Internet Protocol Version 4, Src: 24.6.181.160 (24.6.181.160), Dst: 8
Transmission Control Protocol, Src Port: opsmgr (1270), Dst Port: htt
File: "C:\Users\Laura... Packets: 519 Displayed: 32 Marked: 0 Load time: 0:00.067
Profile: wireshark101


challenge101-3.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: dns
Expression... Clear Apply Save
No. Time Source Destination Protocol Info
396 0.000000 2001:558:6045 2001:558:feed: DNS Standard query 0xf7a5 A
397 0.187676 2001:558:feed 2001:558:6045: DNS Standard query response
398 0.001206 2001:558:6045 2001:558:feed: DNS Standard query 0xcba7 A
399 0.215063 2001:558:feed 2001:558:6045: DNS Standard query response
480 9.049289 2001:558:6045 2001:558:feed: DNS Standard query 0xed4a A
482 0.268204 2001:558:feed 2001:558:6045: DNS Standard query response
483 0.002437 2001:558:6045 2001:558:feed: DNS Standard query 0x1bc1 A
484 0.265009 2001:558:feed 2001:558:6045: DNS Standard query response
File: "C:\Users\Laura... Packets: 519 Displayed: 8 Marked: 0 Load time: 0:00.064 Profile: wireshark101


challenge101-3.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: tcp.flags.syn==1
Expression... Clear Apply Save
No. Time Source Destination Protocol Info
1 0.000000 2001:558:6045 2001:4860:4001 TCP openvpn > http [SYN] Se
2 0.000961 2001:558:6045 2001:4860:4001 TCP rsf-1 > http [SYN] Seq=
3 0.014608 2001:4860:400 2001:558:6045: TCP http > rsf-1 [SYN, ACK]
6 0.001548 2001:4860:400 2001:558:6045: TCP http > openvpn [SYN, AC
466 65.255117 2001:558:6045 2001:4860:4001 TCP propel-msgsys > http [S
467 0.027720 2001:4860:400 2001:558:6045: TCP http > propel-msgsys [S
485 6.428263 24.6.181.160 80.78.246.209 TCP opsmgr > http [SYN] Seq
486 0.000813 24.6.181.160 80.78.246.209 TCP excw > http [SYN] Seq=0
File: "C:\Users\Laura... Packets: 519 Displayed: 12 Marked: 0 Load time: 0:00.064 Profile: wireshark101

Chapter 3 Challenge Answers

Answer 3-1.

Using the filter ip.addr==80.78.246.209, we determined that 32 packets traveled to or from

80.78.246.209.

Answer 3-2.

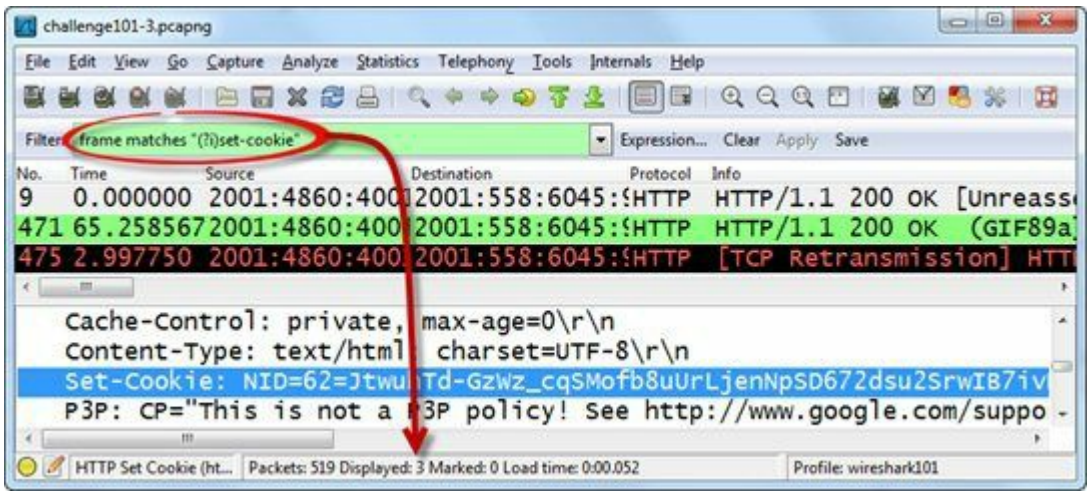
Based on a dns filter, we determined that there are 8 DNS packets in the trace file.

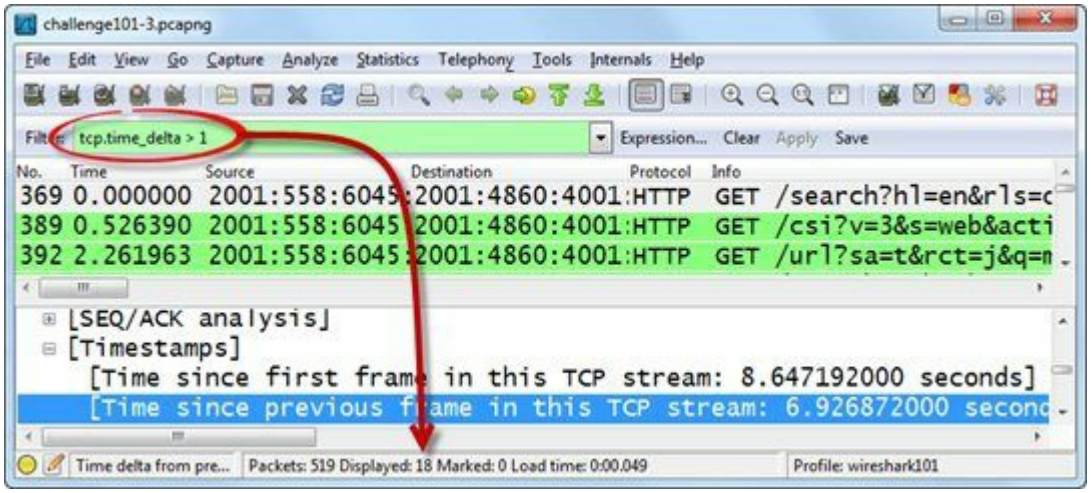
Answer 3-3.

Based on a tcp.flags.syn==1 filter, we determined that there are 12 TCP packets with the TCP

SYN flag set on in this trace file.

Answer 3-4.


challenge101-3.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: frame matches "(?i)set-cookie"
Expression... Clear Apply Save
No. Time Source Destination Protocol Info
9 0.000000 2001:4860:400 2001:558:6045: HTTP HTTP/1.1 200 OK [Unreass
471 65.258567 2001:4860:400 2001:558:6045: HTTP HTTP/1.1 200 OK (GIF89a
475 2.997750 2001:4860:400 2001:558:6045: HTTP [TCP Retransmission] HTT
Cache-Control: private, max-age=0\r\n
Content-Type: text/html; charset=UTF-8\r\n
Set-Cookie: NID=62=JtwuTd-GzWz_cqSMofb8uUrLjenNpSD672dsu2SrwIB7iv
P3P: CP="This is not a P3P policy! See http://www.google.com/suppo
HTTP Set Cookie (ht... Packets: 519 Displayed: 3 Marked: 0 Load time: 0:00.052 Profile: wireshark101


challenge101-3.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: tcp.time_delta > 1
Expression... Clear Apply Save
No. Time Source Destination Protocol Info
369 0.000000 2001:558:6045 2001:4860:4001 HTTP GET /search?hl=en&rls=c
389 0.526390 2001:558:6045 2001:4860:4001 HTTP GET /csi?v=3&s=web&acti
392 2.261963 2001:558:6045 2001:4860:4001 HTTP GET /url?sa=t&rct=j&q=m
[SEQ/ACK analysis]
[Timestamps]
[Time since first frame in this TCP stream: 8.647192000 seconds]
[Time since previous frame in this TCP stream: 6.926872000 second
Time delta from pre... Packets: 519 Displayed: 18 Marked: 0 Load time: 0:00.049 Profile: wireshark101

Based on a frame matches "(?i)set-cookie" filter, we determined that three packets

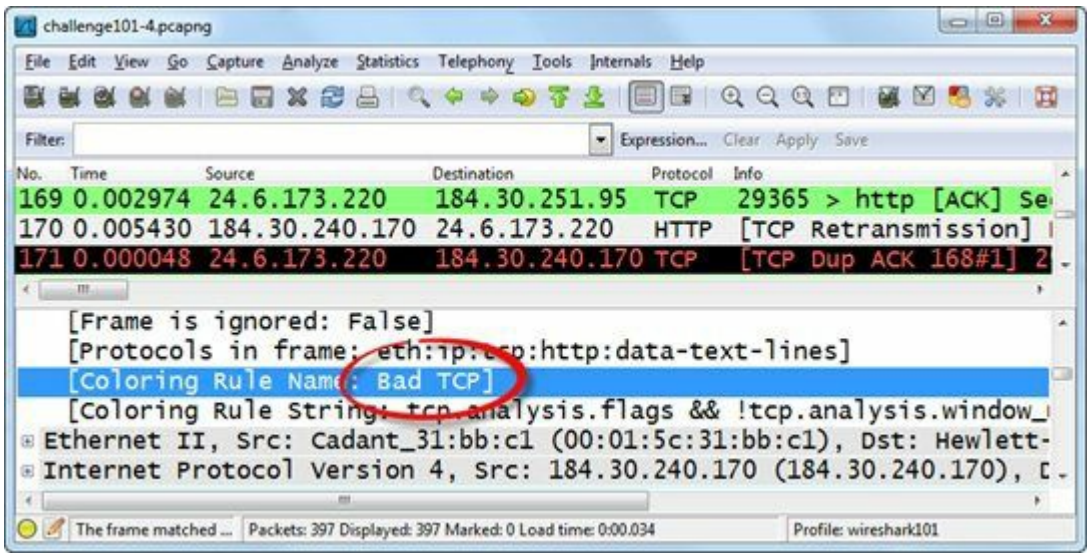
contained this string. We disabled *Allow subdissector to reassemble TCP streams* in TCP Preferences

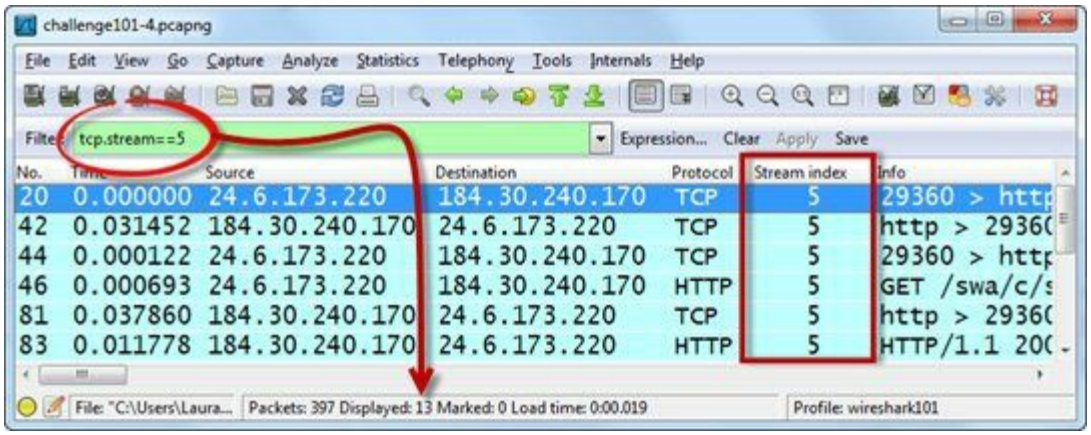
in order to see the response code 200 OK in frame 9.

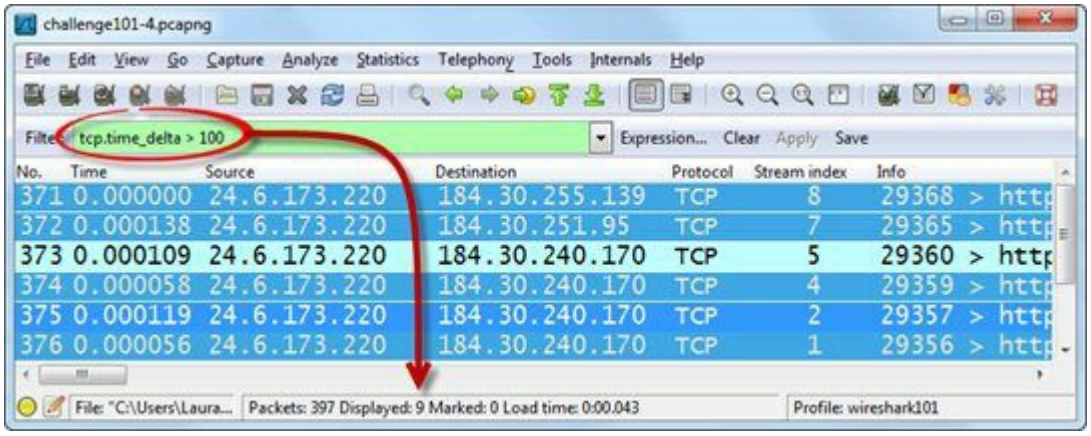
Answer 3-5.

Based on a tcp.time_delta > 1 filter, we determined that 18 TCP frames arrived with over a 1

second delay preceding them.


challenge101-4.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Info
169 0.002974 24.6.173.220 184.30.251.95 TCP 29365 > http [ACK] Se
170 0.005430 184.30.240.170 24.6.173.220 HTTP [TCP Retransmission]
171 0.000048 24.6.173.220 184.30.240.170 TCP [TCP Dup ACK 168#1] 2
[Frame is ignored: False]
[Protocols in frame: eth:ip:tcp:http:data-text-lines]
[Coloring Rule Name: Bad TCP]
[Coloring Rule String: tcp.analysis.flags && !tcp.analysis.window_
Ethernet II, Src: Cadant_31:bb:c1 (00:01:5c:31:bb:c1), Dst: Hewlett-
Internet Protocol Version 4, Src: 184.30.240.170 (184.30.240.170),
The frame matched ... Packets: 397 Displayed: 397 Marked: 0 Load time: 0:00.034
Profile: wireshark101


challenge101-4.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: tcp.stream==5
Expression... Clear Apply Save
No. Time Source Destination Protocol Stream index Info
20 0.000000 24.6.173.220 184.30.240.170 TCP 5 29360 > http
42 0.031452 184.30.240.170 24.6.173.220 TCP 5 http > 29360
44 0.000122 24.6.173.220 184.30.240.170 TCP 5 29360 > http
46 0.000693 24.6.173.220 184.30.240.170 HTTP 5 GET /swa/c/s
81 0.037860 184.30.240.170 24.6.173.220 TCP 5 http > 29360
83 0.011778 184.30.240.170 24.6.173.220 HTTP 5 HTTP/1.1 200
File: "C:\Users\Laura... Packets: 397 Displayed: 13 Marked: 0 Load time: 0:00.019
Profile: wireshark101


challenge101-4.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: tcp.time_delta > 100
Expression... Clear Apply Save
No. Time Source Destination Protocol Stream index Info
371 0.000000 24.6.173.220 184.30.255.139 TCP 8 29368 > http
372 0.000138 24.6.173.220 184.30.251.95 TCP 7 29365 > http
373 0.000109 24.6.173.220 184.30.240.170 TCP 5 29360 > http
374 0.000058 24.6.173.220 184.30.240.170 TCP 4 29359 > http
375 0.000119 24.6.173.220 184.30.240.170 TCP 2 29357 > http
376 0.000056 24.6.173.220 184.30.240.170 TCP 1 29356 > http
File: "C:\Users\Laura... Packets: 397 Displayed: 9 Marked: 0 Load time: 0:00.043
Profile: wireshark101

Chapter 4 Challenge Answers

Answer 4-1.

Frame 170 matches the **Bad TCP** coloring rule that looks for TCP analysis flagged packets (except

Window Update packets).

Answer 4-2.

We applied a filter for **tcp.stream==5** and then right-clicked on one line in the Packet List pane.

We selected **Colorize Conversation | TCP** and selected **Color 6**. This TCP stream contains 13 frames.

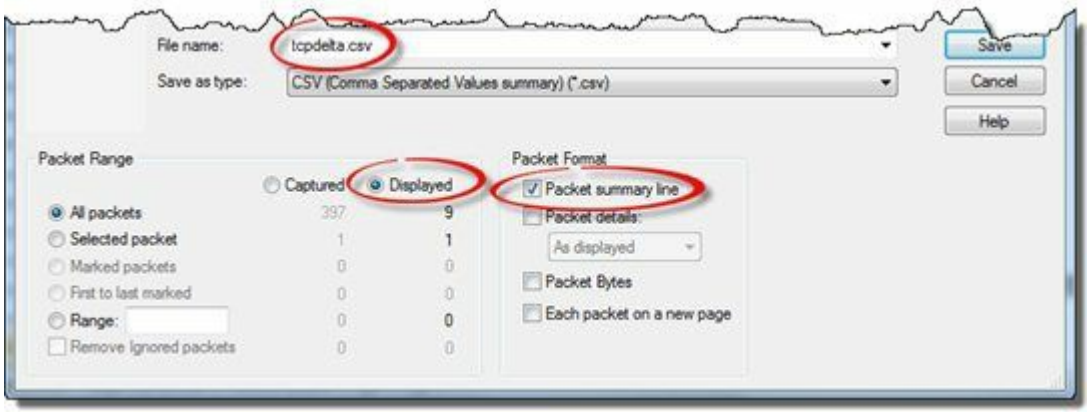
Answer 4-3.

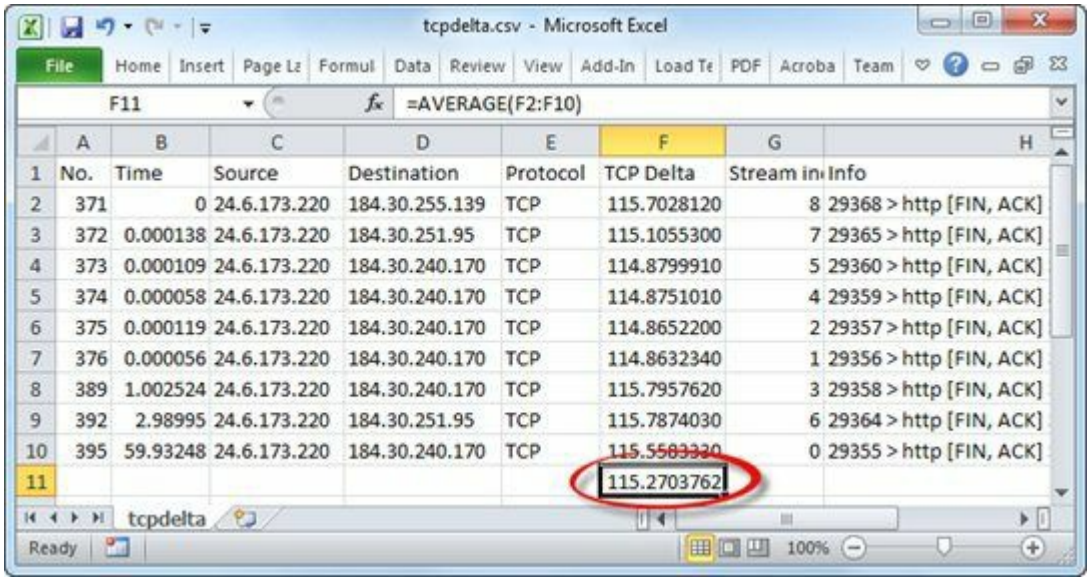
We created a coloring rule using the string tcp.time_delta > 100. We used the same string as

a display filter and found 9 frames matched this filter. One packet still retained our temporary

coloring rule from Question 4-2.

Answer 4-4.



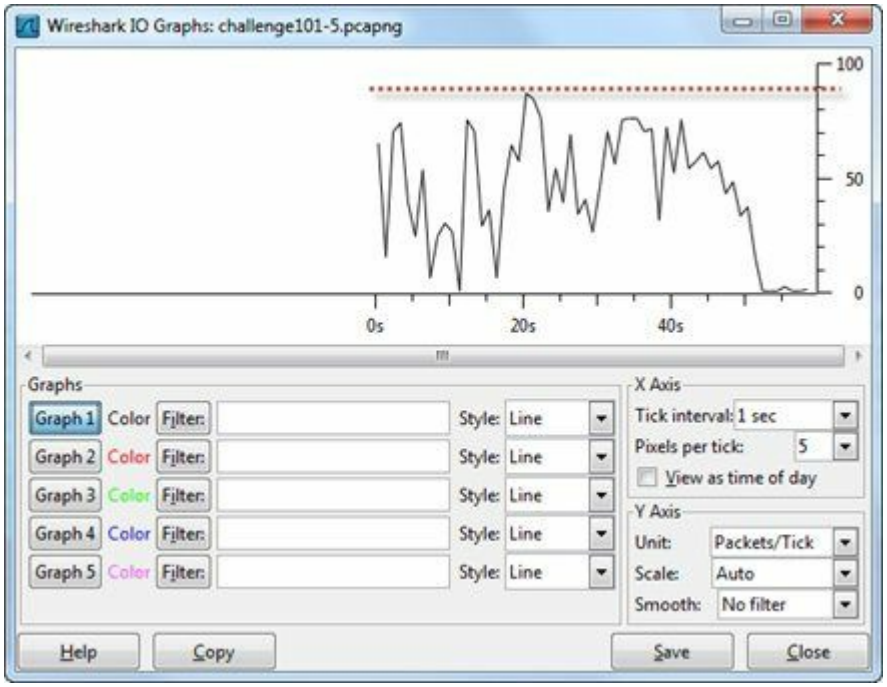


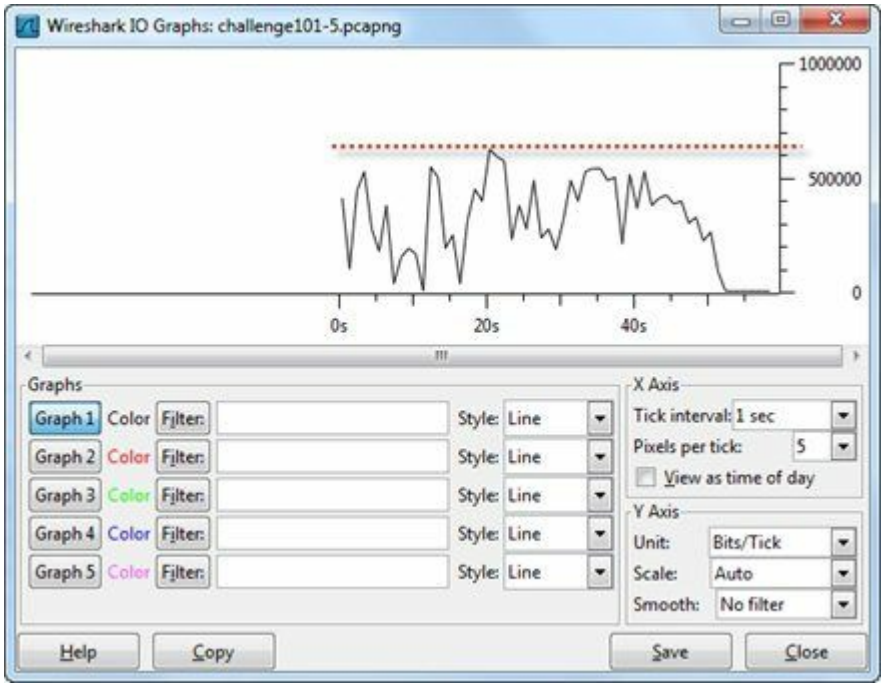
After creating a **TCP Delta** column, we selected **File | Export Packet Dissections | as "CSV"**

format. We selected to export the captured packets and only the Packet summary line.

We opened the .csv file in Excel and determined the average value of the exported **TCP Delta** column

as 115.2703762.





Chapter 5 Challenge Answers

Answer 5-1.

We selected **Statistics | IO Graph** and used the default Packets/Tick unit in the Y axis. The highest

packets-per-second value seen in this trace file is approximately 90 packets per second.

Answer 5-2.

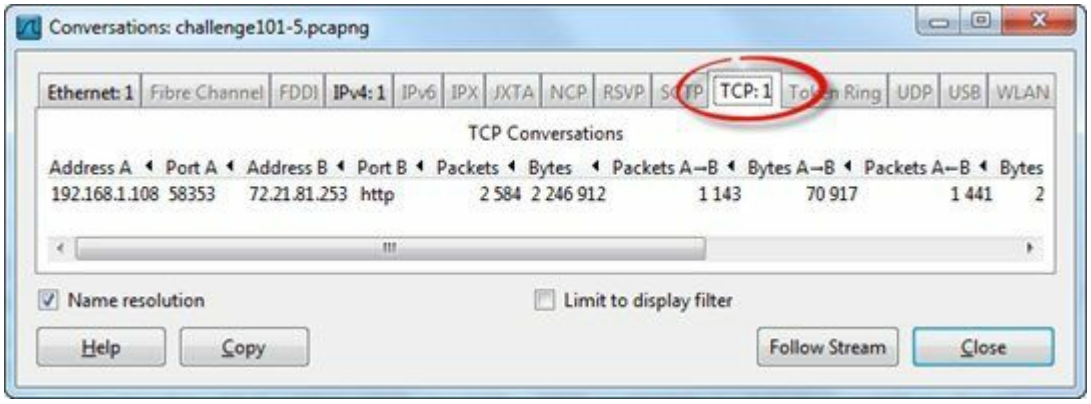
After changing the Y axis to Bits/Tick, we can see the highest bits-per-second value seen in this trace

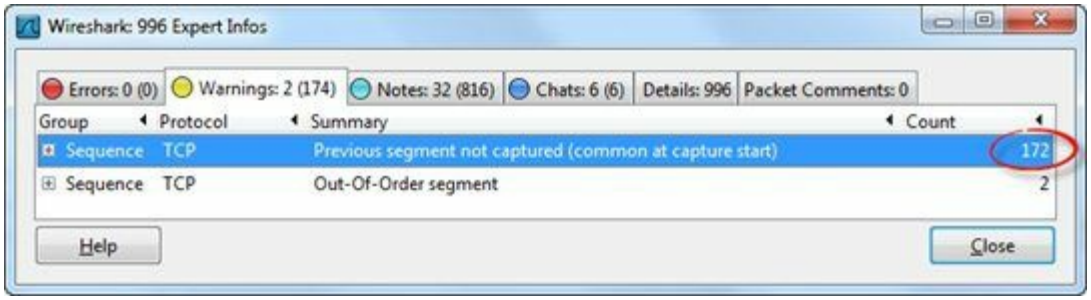
file is approximately 630,000 bits per second.

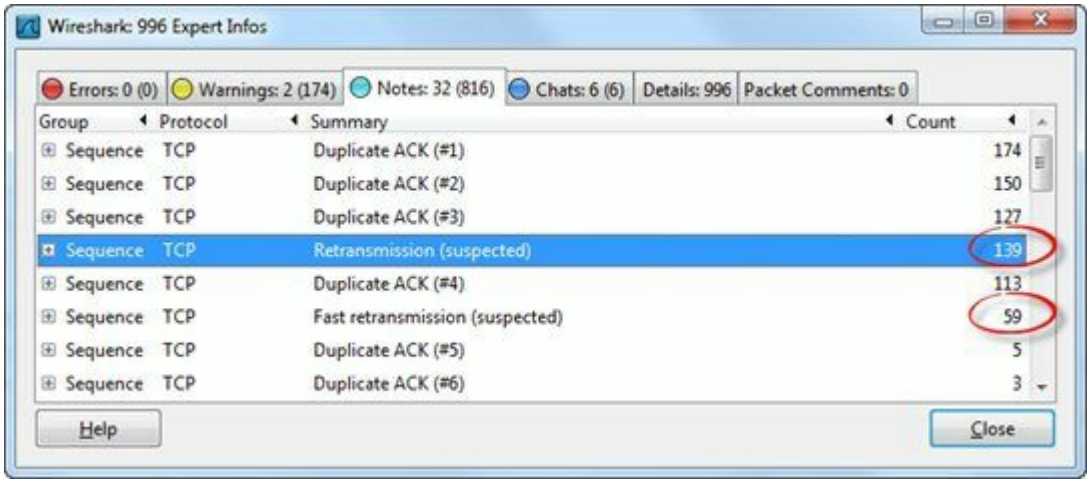
Answer 5-3:

Selecting **Statistics | Conversations | TCP**, we can see there is only one TCP conversation in the trace

file.







Answer 5-4.

After clicking the **Warnings** tab in the Expert Infos window, we can see there are a total of

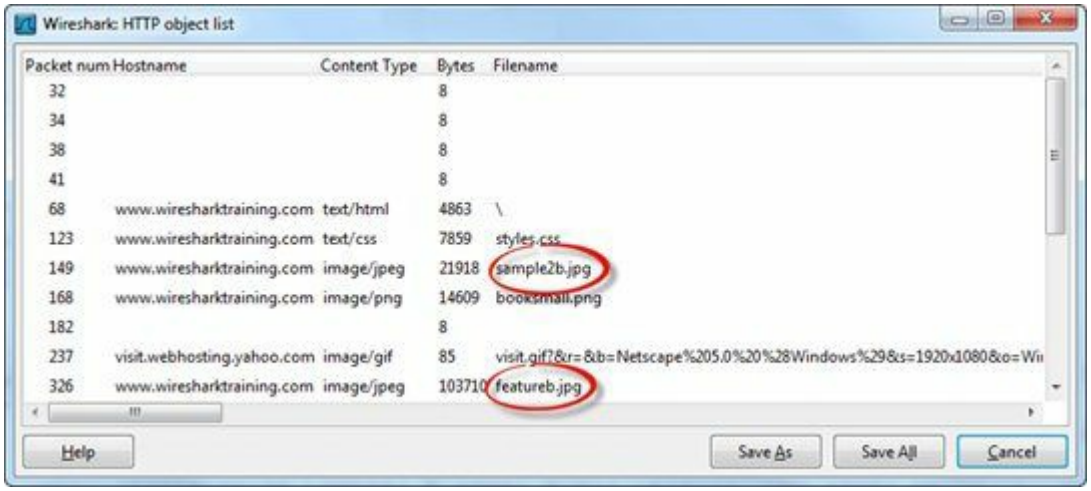
172 *Previous segment not captured* indications. Most likely an interconnecting device along a path is

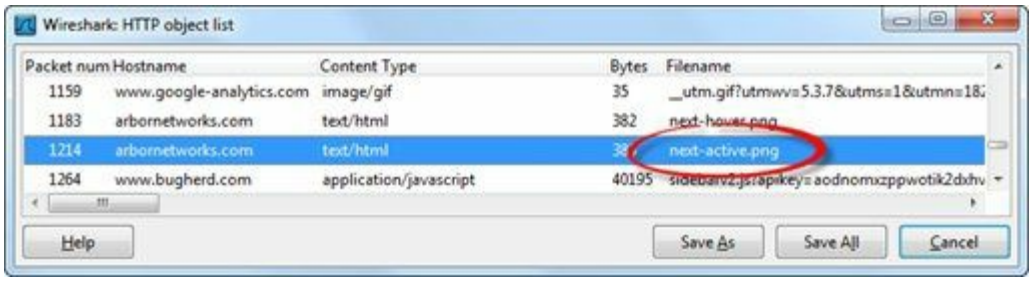
dropping packets.

Answer 5-5.

Clicking on the **Notes** tab, we can see there are a total of 198 Retransmissions and Fast

retransmissions combined. These are the recovery processes for packet loss.





Chapter 6 Challenge Answers

Answer 6-1.

First we made certain that the TCP *Allow subdissector to reassemble TCP streams* preference is

enabled. Then we selected **File | Export Objects | HTTP** to find out which HTTP objects were

transferred in the trace file. The two .jpg files are *sample2b.jpg* and *featureb.jpg*.

Answer 6-2.

Scrolling down in the HTTP object list, we see ***next-active.png*** listed with *arbornetworks.com*.

When you click on this entry to jump to packet 1,214, however, we see a 301 Moved Permanently

response indicating the file is at

http://www.arbornetworks.com/modules/mod_arborslideshow/tmpl/img/icon/slider/next-active.png.

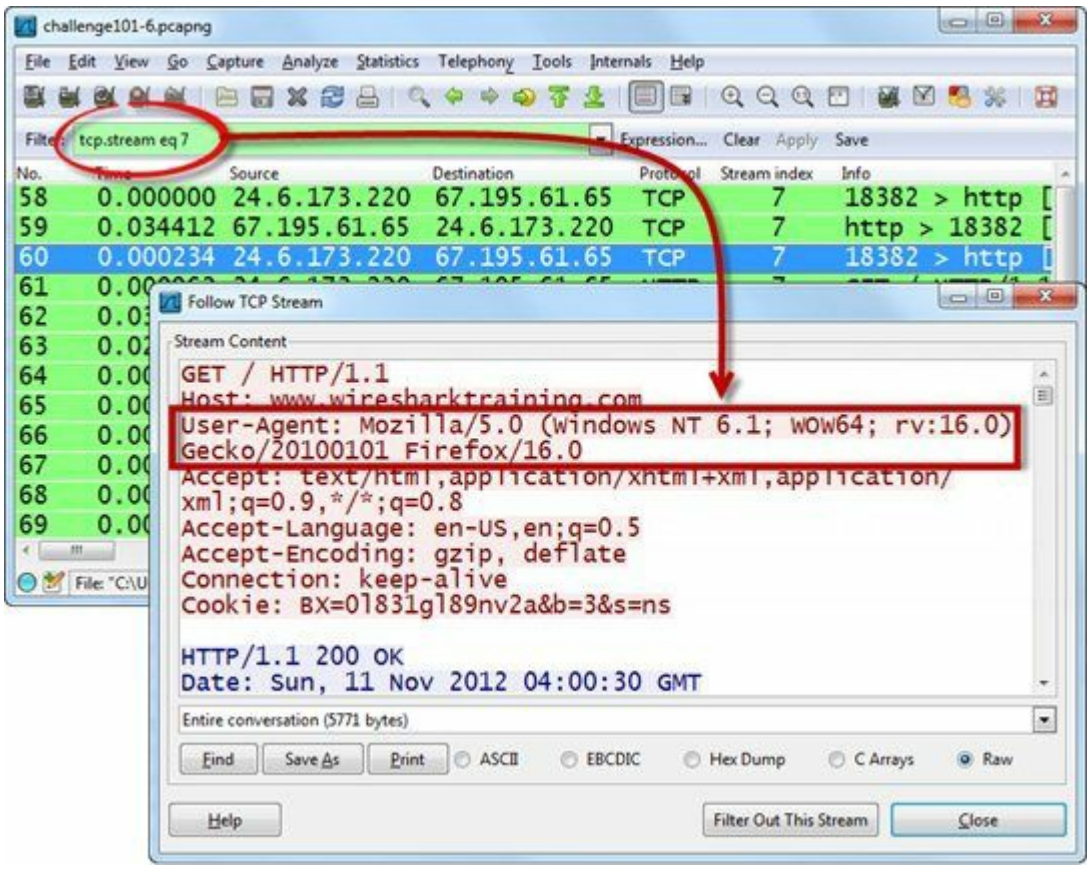
Answer 6-3.

We selected ***booksmall.png*** and selected **Save As**. This file depicts the top half of the Wireshark Network Analysis book on an orange background.

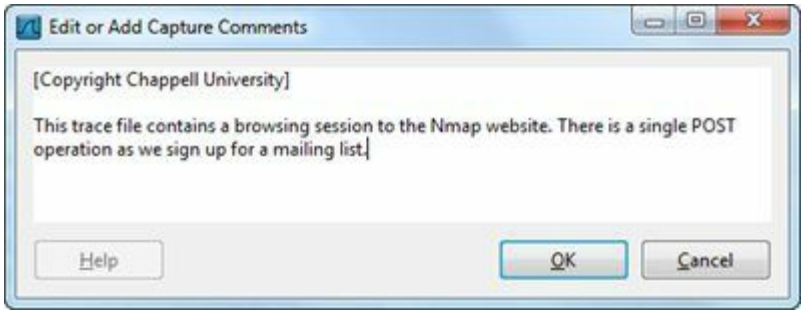
Answer 6-4.

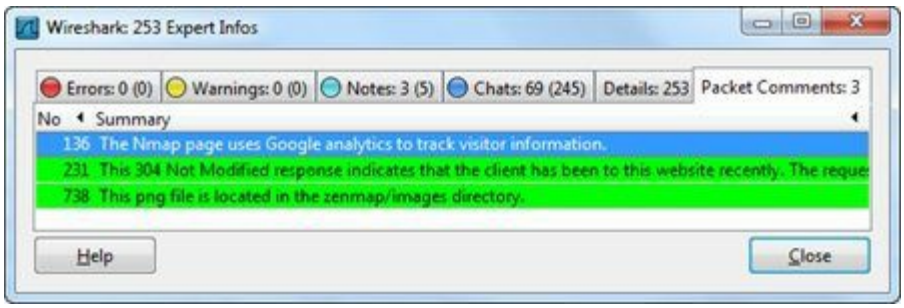
We filtered the trace file on **tcp.stream eq 7** before right-clicking on a frame and selecting

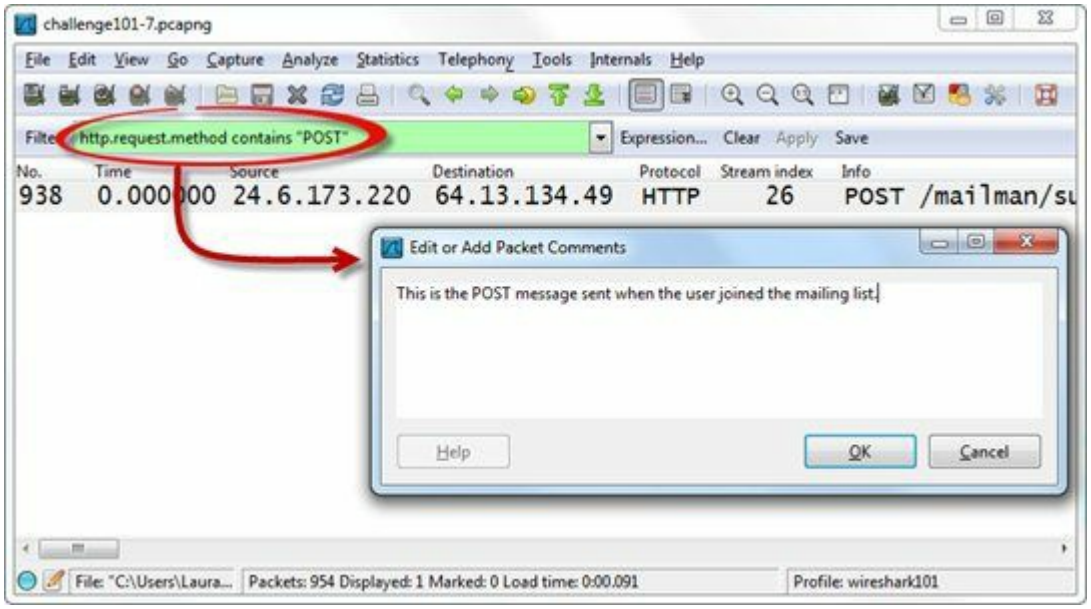
Follow TCP stream. This client is using Firefox to browse *www.wiresharktraining.com* in this


challenge101-6.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: tcp.stream eq 7
Expression... Clear Apply Save
No. Time Source Destination Protocol Stream index Info
58 0.000000 24.6.173.220 67.195.61.65 TCP 7 18382 > http
59 0.034412 67.195.61.65 24.6.173.220 TCP 7 http > 18382
60 0.000234 24.6.173.220 67.195.61.65 TCP 7 18382 > http
Follow TCP Stream
Stream Content
GET / HTTP/1.1
Host: www.wiresharktraining.com
User-Agent: Mozilla/5.0 (Windows NT 6.1; WOW64; rv:16.0) Gecko/20100101 Firefox/16.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Connection: keep-alive
Cookie: BX=0l831gl89nv2a&b=3&s=ns
HTTP/1.1 200 OK
Date: Sun, 11 Nov 2012 04:00:30 GMT
Entire conversation (5771 bytes)
Find Save As Print ASCII EBCDIC Hex Dump C Arrays Raw
Help Filter Out This Stream Close

conversation.


Edit or Add Capture Comments
[Copyright Chappell University]
This trace file contains a browsing session to the Nmap website. There is a single POST operation as we sign up for a mailing list.
Help OK Cancel


Wireshark: 253 Expert Infos
Errors: 0 (0) Warnings: 0 (0) Notes: 3 (5) Chats: 69 (245) Details: 253 Packet Comments: 3
No Summary
136 The Nmap page uses Google analytics to track visitor information.
231 This 304 Not Modified response indicates that the client has been to this website recently. The reque
738 This png file is located in the zenmap/images directory.
Help Close


challenge101-7.pcapng
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: http.request.method contains "POST"
Expression... Clear Apply Save
No. Time Source Destination Protocol Stream index Info
938 0.000000 24.6.173.220 64.13.134.49 HTTP 26 POST /mailman/su
Edit or Add Packet Comments
This is the POST message sent when the user joined the mailing list.
Help
OK
Cancel
File: "C:\Users\Laura... Packets: 954 Displayed: 1 Marked: 0 Load time: 0:00.091
Profile: wireshark101

Chapter 7 Challenge Answers

Answer 7-1.

We clicked on the trace file **Annotation** button on the Status Bar to see a copyright notice and some

basic information about the trace file.

Answer 7-2.

We clicked on the **Expert Infos** button on the Status Bar and then the **Packet Comments** tab to view

three packet comments.

Answer 7-3.

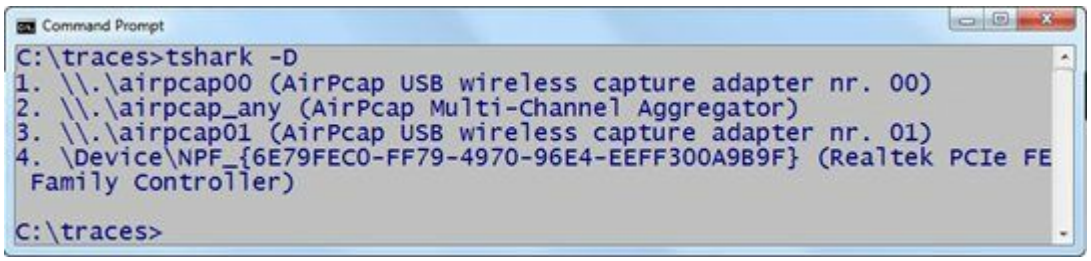
We applied a filter for **http.request.method contains "POST"** to find the POST packet

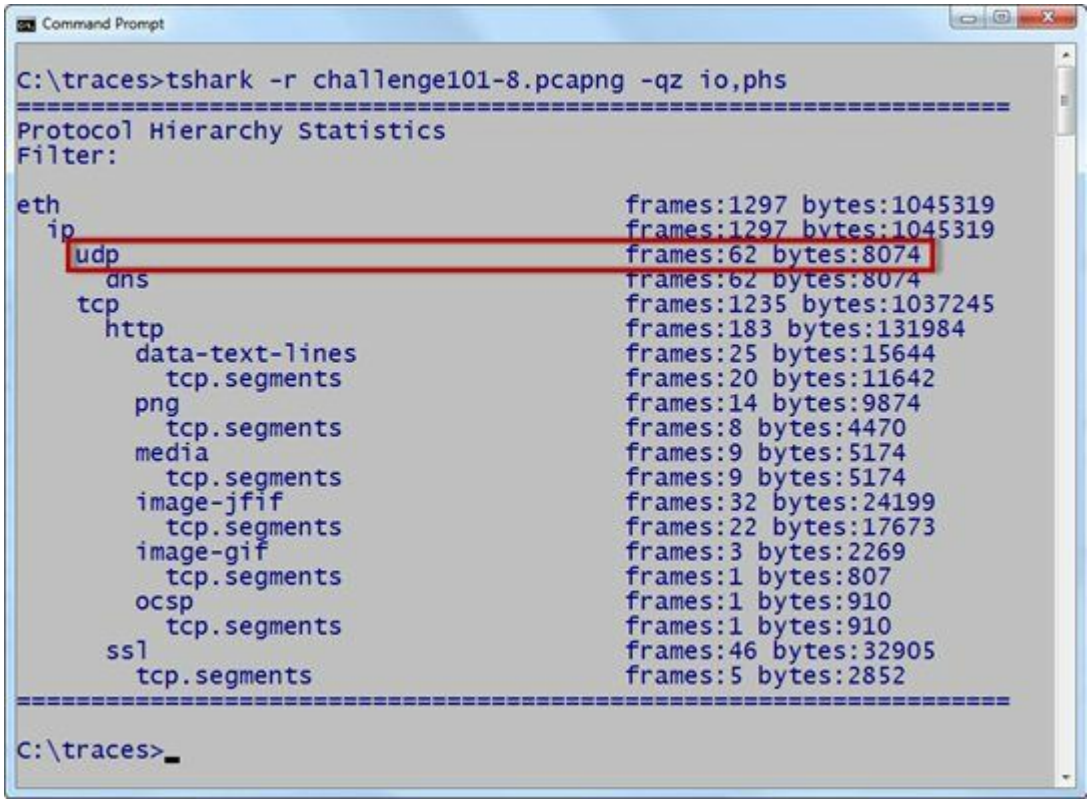
(938). Then we right-clicked on that packet and selected **Edit or Add Packet Comment** before typing

in our message.

The filter **http.request.method=="POST"** or even **http.request.method matches**

"POST" would have worked as well.


Command Prompt
C:\traces>tshark -D
1. \\.\airpcap00 (AirPcap USB wireless capture adapter nr. 00)
2. \\.\airpcap_any (AirPcap Multi-Channel Aggregator)
3. \\.\airpcap01 (AirPcap USB wireless capture adapter nr. 01)
4. \Device\NPF_{6E79FEC0-FF79-4970-96E4-EEFF300A9B9F} (Realtek PCIe FE
Family Controller)
C:\traces>



Chapter 8 Challenge Answers

Answer 8-1.

You should use the –D parameter to list active interfaces on your Wireshark system.

Answer 8-2.

Using tshark –r challenge101-8.pcapng –qz io,phs, we determined that there are 62

UDP frames in *challenge101-8.pcapng*.

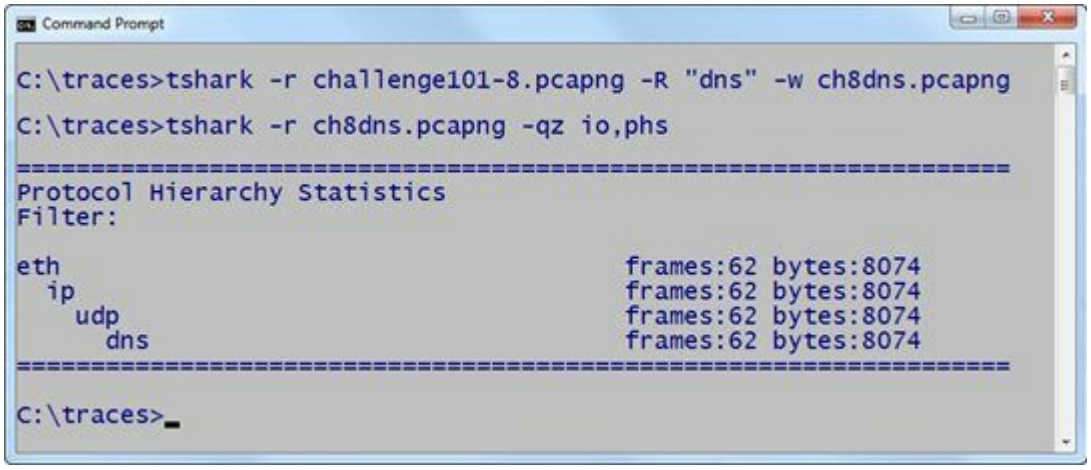
Answer 8-3.

Using the command tshark –r challenge101-8.pcapng –R "dns" –w

ch8dns.pcapng, we exported the DNS traffic and found that there are 62 DNS packets. Apparently

all the UDP traffic is DNS.

We could have used capinfos ch8dns.pcapng to obtain the packet count as well.



Appendix B: Trace File Descriptions

"Protocol Analysis is the only way to really see how applications and networks behave. Unfortunately

the tools are only as good as the training and knowledge you gain. More practice = more knowledge."

Tony Fortunato

Senior Network Performance Specialist, The Technology Firm

and Wireshark University Certified Instructor

Practice Trace Files

The book web site (*www.wiresharkbook.com*) contains all the trace files mentioned in this book.

Please note the license for use below and on the book web site.

You agree to indemnify and hold Protocol Analysis Institute and its subsidiaries, affiliates, officers,

agents, employees, partners and licensors harmless from any claim or demand, including reasonable

attorneys' fees, made by any third party due to or arising out of your use of the included trace files,

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any of the trace files available at *www.wiresharkbook.com.*

dhcp-serverdiscovery101.pcapng—This trace file only contains DHCP traffic. Note that the display

filter required to view DHCP traffic is simply bootp. [Chapter 3]

dns-nmap101.pcapng—We saved the DNS traffic from a browsing session that included an attempt

to reach *www.nmap.org* and *www.insecure.org* (both managed by Fyodor, the creator of Nmap) as well as *google.com* and

dropbox.com. It seems there are some DNS problems that will prevent us from

getting to Fyodor's sites. [Chapter 1]

ftp-clientside101.pcapng—Wireshark is running on a client to capture the FTP command and data

channel traffic seen in this trace file. The user name and password are visible in clear text. We can use

Follow TCP Stream to reassemble the file transferred in this trace file. [Chapter 3 and 6]

ftp-crack101.pcapng—We started capturing in the middle of a password cracking attempt. This is a

good trace file on which to practice keyword filtering. Was the password cracking attempt successful?

[Chapter 3 and Chapter 4]

ftp-download101.pcapng—The FTP banner is quite evident in the Packet List pane of this trace file.

Follow the stream of the command channel to see what the client wants from the server. Practice

finding the most active conversations based on bytes and applying a filter for that traffic. [Chapter 6]

general101.pcapng—This is the trace file we followed to build a picture of a network. We examined

the MAC addresses and IP addresses contained in the trace file. [Chapter 0]

general101b.pcapng—An outside host (121.125.72.180) and an inside host (24.6.169.43) are trying to

make a connection to a local host. Consider building a display filter for all TCP SYN packets to detect

connection attempts and responses. [Chapter 3 and Chapter 5]

general101c.pcapng—We used this trace file to detect suspicious traffic on a network. Look at the

Protocol Hierarchy to identify the IRC traffic and use Follow TCP Stream to reassemble the traffic

and identify commands. What is the name of the IRC server? [Chapter 5]

general101d.pcapng—This trace file contains numerous TCP problems. Open the Expert Infos

window to identify the problems on this network. [Chapter 5]

gen-startupchatty101.pcapng—We used this trace file to examine conversation statistics. The trace

file contains 15 IPv4 conversations and 12 IPv6 conversations. Although there are only 6 TCP

conversations, there are 52 UDP conversations. [Chapter 3]

http-au101b.pcapng—We used this trace file to track a web browsing session and export the HTTP

Host field values. We then exported the Packet List pane columns to a CSV file for further processing.

[Chapter 4]

http-browse101.pcapng—This trace file contains a web browsing session. This is a good trace file to

use to practice adding columns or filtering on DNS traffic to identify web site dependencies. [Chapters

3, 4 and 6]

http-browse101b.pcapng—This trace file contains IPv4 and IPv6 traffic. We used this trace file to

examine the Protocol Hierarchy window. [Chapters 5]

http-browse101c.pcapng—This trace file contains traffic between a host in the United States and

hosts in China. This is a great trace file to use when practicing GeoIP mapping. [Chapter 5]

http-browse101d.pcapng—This trace file contains numerous intertwined conversations. Practice

differentiating the conversations by applying temporary coloring rules to the separate conversations.

[Chapter 4]

http-chappellu101.pcapng—This trace file contains a very simple web browsing session. Use this

file to practice reassembling web objects. [Chapter 1]

http-chappellu101b.pcapng—In this browsing session, the user decided to open a PDF file located on

the web site. Looking closely at the trace file we can see the browser used an external PDF viewing

software. Checking in to that viewer site, we detected a 404 error. [Chapter 3]

http-cheez101.pcapng—This trace file depicts a browsing session to the infamous *cheezburger.com*

site. Try opening this trace file with the TCP *Allow subdissector to reassemble TCP streams*

preference enabled and disabled. You can see the difference in frame 10. [Chapter 7]

http-college101.pcapng—This is another good trace file that contains a large number of connections

required to browse a single web site. Peruse through the GET requests to see some interesting .jpg file

names. [Chapter 6]

http-disney101.pcapng—It's the "happiest place on Earth"... if you can get there. This trace file depicts DNS errors that are slowing down the browsing session. [Chapters 1, 3, and 8]

http-download101.pcapng—This trace file contains some very serious TCP problems. Use the Expert

Infos window to identify the errors. Pay attention to the packet time information to determine how

heavily these errors affected performance. [Chapters 5 and 8]

http-download101c.pcapng—Filter on the GET requests to see what the client is downloading in this

trace file. Consider creating a coloring rule based on your findings. [Chapter 8]

http-download101d.pcapng—There are numerous problems in this trace file. Create an IO Graph that

compares all traffic with the TCP analysis flagged packets. [Chapter 3]

http-download101e.pcapng—Again, we have errors in the trace file that are affecting the throughput.

Create another IO Graph with the TCP analysis flagged packets. You probably need to set the Y axis to

logarithmic to see the relationship between TCP errors and drops in throughput. [Chapter 5]

http-errors101.pcapng—In this trace file a user is trying to load a page that does not exist. Practice

setting up coloring rules for HTTP error response codes using this trace file. [Chapter 3]

http-espn101.pcapng—When you browse to *www.espn.com*, you will find that there's nothing there.

This trace file shows the interdependencies between web sites. You may think you are connecting to a

single site, when you are actually connecting to multiple sites. [Chapters 1, 3, 5, 6, and 8]

http-google101.pcapng—In this trace file we received IPv4 and IPv6 addresses in response to our

DNS queries. Did any of our communications travel over IPv6? [Chapter 0]

http-jezebel101.pcapng—Look in the Frame section in this trace file. It was taken the day after

Hurricane Sandy hit the East Coast of the United States. Numerous servers on the East Coast were

knocked out by the floods. This site, *jezebel.com*, was hosted on a Datagram server that was located in

a flooded basement. Reassemble the TCP streams to clearly read the responses from the temporary

server to which traffic was directed. [Chapter 4]

http-misctraffic101.pcapng—Try to reassemble the executable transferred during this web browsing

session. It is fully functional, but it may not be the latest copy available. [Chapters 4 and 5]

http-nonstandard101.pcapng—In this trace file we have HTTP traffic traveling over a non-standard

port number. You can adjust the HTTP preference settings to dissect this traffic properly. [Chapter 1]

http-openoffice101a.pcapng—This trace file depicts a slow server response. Use the **Time** column

and the TCP *Calculate conversation timestamps* feature to determine the length of the delay.

http-openoffice101b.pcapng—During this OpenOffice download, the client terminates the

connection to the server. It takes the server a while to receive the TCP Resets, however, so the trace

file ends with a number of unacknowledged data packets. [Chapter 1]

http-pcaprnet101.pcapng—There is a noticeable delay when accessing *pcapr.net* information. Use

the **Time** column and the TCP conversation timestamp details to analyze the performance of this

browsing session. [Chapter 1]

http-pictures101.pcapng—We are browsing for images at *istockphoto.com*. Practice exporting HTTP

objects using this file. Can you tell what search term we used on the iStockphoto site? [Chapter 3]

http-sfgate101.pcapng—This trace file contains a browsing session to *sfgate.com*, an online

newspaper owned by the Hearst Corporation. Use your HTTP filtering capabilities to detect the POST

message. [Chapters 3 and 4]

http-slow101.pcapng—This trace file depicts a really slow communication between an HTTP client

and a server. It's a great trace file to practice your "high latency" coloring rules and display filters.

[Chapter 1]

http-winpcap101.cap—This file was captured with Microsoft's Network Monitor. Wireshark can

open the trace file easily using Wireshark's Wiretap Library. [Chapter 0]

http-wiresharkdownload101.pcapng—Use this trace file to compare the results of an http filter

with a tcp.port==80 filter. Notice the value of the **Protocol** column as you apply these filters.

[Chapters 3 and 6]

mybackground101.pcapng—This trace file was taken to determine what background traffic occurs

on a lab system. As we removed "normal" traffic from view, we detected an incoming connection

attempt from a foreign host. [Chapters 0 and Chapter 3]

sec-concern101.pcapng—This trace file contains some very unsettling traffic. Open the Protocol

Hierarchy window and export the suspicious traffic to get a better feel for what is taking place.

[Chapter 5]

sec-nessus101.pcapng—This trace file depicts a Nessus scan. You'll notice a wide range of colors

applied to the packets and a very interesting Protocol Hierarchy view. [Chapter 4]

sec-suspicous101.pcapng—This browsing session illustrates a redirection to a cz.cc site. Note that in

2011, Google blacklisted all sites under the cz.cc domain stating "Over the past 90 days, cz.cc

appeared to function as an intermediary for the infection of 13788 site(s) including *uniform-net.jp/*,

nuxi-navi.com/, *flashracingonline.com/*." [Chapter 7]

smb-join101.pcapng—This trace contains the SMB traffic from a Windows host that joins a domain.

Use this trace file to test your coloring rule or display filter for SMB errors. [Chapter 3]

tcp-decodeas.pcapng—This traffic runs over a non-standard port number. In fact, Wireshark does not

have a dissector for the port used. Follow the stream to figure out what the traffic is and then force a

dissector using right-click **Decode As**. [Chapter 1]

wlan-ipadstartstop101.pcapng—This trace file contains the 802.11 traffic from an iPad during the

startup and shut down procedure. This trace file was taken with an AirPcap adapter and includes a

Radiotap header. The data is not visible because the traffic is encrypted. [Chapter 3]

Network Analyst's Glossary

***Note**: This Glossary defines terms as they relate to network analysis and Wireshark functionality.*

6to4 traffic—6to4 traffic contains IPv6 packets embedded inside IPv4 headers. These packets can be

routed through an IPv4 network to a target IPv6 host. Apply a display filter for ip and ipv6 to detect

traffic that contains both protocols.

ACK—Short for Acknowledgement, this term is used to refer to the packets that are sent to

acknowledge receipt of some packet on a TCP connection. For example, a handshake packet (SYN)

containing an initial sequence number is acknowledged with SYN/ACK. A data packet would also be

acknowledged.

AirPcap—This specialized wireless adapter was originally created by CACE Technologies (now

owned by Riverbed) to capture wireless network traffic. Designed to work on Windows hosts, this

adapter can capture traffic in promiscuous mode (capture traffic sent to all target hardware addresses,

not just the local hardware address) and monitor mode (capture traffic on all wireless networks by not

joining any wireless network). For more information, visit *www.riverbed.com*.

Annotations—As of Wireshark 1.8, annotations, or comments, can be added to an entire trace file or

to individual packets. Trace file annotations can be seen by clicking on the **Annotation** button on the

Status Bar or by selecting **Statistics | Summary**. Packet annotations can be seen above the Frame

section of a packet in the Packet Details pane or by opening the **Expert Infos** window and selecting

the **Packet Comments** tab. The display filter comment will show you all packets that contain

comments. Add this as a column to read all comments in the Packet List pane.

Apply as Filter—After right-clicking on a field, conversation, endpoint, or protocol/application you

can apply a display filter immediately using this option.

ARP (Address Resolution Protocol)—ARP packets are sent to determine if someone is using a

particular IP address on a network (gratuitous ARP) or to locate a local host's hardware address (ARP

requests/replies). Both the capture and display filters for ARP are simply arp.

ASCII (American Standard Code for Information Interchange)– ASCII is a character encoding

mechanism seen in the Packet Bytes pane. When you highlight a text field in the Packet Details pane,

the hex and ASCII location of that field is highlighted in the Packet Bytes pane.

background traffic—This traffic type occurs with no user-intervention. Typical background traffic

may include virus detection tool updates, OS updates, and broadcasts, or multicasts from other devices

on the network. Start capturing traffic on your own computer and then walk away. Let the capture run

for a while to get a baseline of your machine's background traffic.

Berkeley Packet Filtering (BPF) Syntax—This is the syntax used by Wireshark capture filters. This

filtering format was originally defined for tcpdump, a command-line capture tool. For more

information on Wireshark capture filter syntax, see *wiki.wireshark.org/CaptureFilters.*

Bootstrap Protocol, see *BOOTP*

BOOTP (Bootstrap Protocol)—This protocol offered static address assignment and is the

predecessor of DHCP (Dynamic Host Configuration Protocol). BOOTP offers dynamic address

assignment. IPv4 DHCP packets contain a BOOTP header and can be filtered on using the bootp

display filter for DHCPv4 and dhcpv6 for DHCPv6. Also see *DHCP*.

broadcast—Broadcast is a type of address that indicates "everyone" on this network. The Ethernet MAC-layer broadcast address is 0xFF:FF:FF:FF:FF:FF. The IPv4 broadcast address is

255.255.255.255 whereas a subnet broadcast would be 10.2.255.255 on network 10.2.0.0. Broadcasts to

the 255.255.255.255 address are not forwarded by routers, but they are forwarded out all switch ports.

Subnet broadcasts may be forwarded by a router if that router is configured to do so.

Capinfos–This command-line tool is included in the Wireshark download and can be used to obtain

basic information about a trace file such as file size, capture duration and checksum value. If you are

going to use a trace file as evidence of a security breach, consider obtaining file checksum values

immediately after saving trace files to prove the trace file has not been tampered with. The command

capinfos –H <filename> will generate SHA1, RMD160 and MD5 checksum values only

whereas capinfos <filename> will generate checksum values as well as all other file

information.

Capture Engine–The Capture Engine is responsible for working with the link layer interfaces for

packet capture. Wireshark uses *dumpcap.exe* for the actual capture process.

capture filter—This is a filter that is applied during the capture process only. This filter cannot be

applied to saved trace files. Use this filter type sparingly as you can't retrieve and analyze the traffic

you drop with a capture filter. Use the –f parameter to apply capture filters with Tshark and dumpcap.

capture interface—The capture interface is the hardware device upon which you can capture traffic.

To view available capture interfaces, click on the **Interfaces** button on the main toolbar. If Wireshark

does not see any interfaces, you cannot capture traffic. Most likely the link-layer driver (libpcap,

WinPcap, or AirPcap) did not load properly.

Cascade Pilot®—The traffic visualization tool created by Loris Degioanni. Cascade Pilot can open,

analyze, and visually represent very large trace files with ease. In addition, Cascade Pilot can build

reports based on the charts and graphs, and export key traffic elements to Wireshark for further

analysis. For more information on Cascade Pilot, see *www.riverbed.com.*

checksum errors—When you enable checksum validation for IP, UDP, or TCP in the protocol

preferences area, Wireshark calculates the checksum values in each of those headers. If the checksum

value is incorrect, Wireshark marks the packet with a checksum error. Since so many machines

support checksum offloading, it is not uncommon to see outbound packets marked with a bad

checksum because the checksum hasn't been applied yet. Turn off checksum validation and/or disable

the Bad Checksum coloring rule to remove these false positives. See also *task offloading*.

CIDR (Classless Interdomain Routing) Notation—This is a way of representing the network portion

of an IP address by appending a bit count value. This value indicates the number of bits that comprise

the network portion of the address. For example, 130.57.3.0/24 indicates that the network portion of

the address is 24-bits long (130.57.3).

Classless Interdomain Routing, see *CIDR Notation*

Comma-Separated Value format, see *CSV format*

comparison operators—Comparison operators are used to look for a value in a field. For example,

ip.addr==10.2.2.2 uses the "equal" comparison operator. Other comparison operators include >,

>=, <, <=, and !=.

core engine—This area of the Wireshark application is considered the "work horse" of Wireshark.

Frames come into the capture engine from the Wiretap Library or from the Capture Engine. Packet

dissectors, display filters, and plugins all work as part of the Core Engine.

CSVformat—Saving to CSV format is available when exporting packet dissections. Using this

format, Wireshark can export all Packet List pane column information for evaluation by another

program, such as a spreadsheet program.

delta time (general)—This time value measures the elapsed time from the end of one packet to the

end of the next packet. Set the **Time** column to this measurement using **View | Time Display Format |**

Seconds since previous packet. This field is inside the Frame section of the Packet Details pane

(called **Time delta from previous displayed frame**).

delta time (TCP)—This time value can be enabled in TCP preferences (*Calculate conversation*

timestamps) and provides a measurement from the end of one TCP packet in a stream to the end of the

next TCP packet in that same stream. The field is added to the end of the TCP header in the

[Timestamps] section. To filter on high TCP delta times, use tcp.time_delta > x, where x is a

number of seconds (x.xxxxxx format is supported as well).

DHCP (Dynamic Host Configuration Protocol)—This protocol is used to dynamically assign IP

addresses and other characteristics to IP clients. The capture filter for IPv4 DHCP traffic is port 67

(alternately you can use port 68). The display filter for IPv4 DHCP traffic is bootp. The capture filter

for DHCPv6 traffic is port 546 (alternately you can use port 547). The display filter for DHCPv6

traffic is dhcpv6.

Dynamic Host Configuration Protocol, see *DHCP*

Differentiated Services Code Point, see *DSCP*

display filter—This filter can be applied during a live capture or to a saved trace file. Display filters can be used to focus on specific types of traffic. Wireshark's display filters use a proprietary format.

Display filters are saved in a text file called *dfilters*. Use the –R parameter to apply display filters

while using Tshark. Dumpcap does not support display filters.

dissectors—Dissectors are the Wireshark software elements that break apart applications and

protocols to display their field names and interpreted values. To view the master list of Wireshark

dissectors, visit *anonsvn.wireshark.org/viewvc/*, select a Wireshark version and navigate to the *epan/dissectors* directory.

DNS (Domain Name System)—DNS is used to resolve names to IP addresses and much more. We are

most familiar with hosts using DNS to obtain the IP address for a host name typed into a URL field of

a browser, but DNS can provide additional information, such as the mail exchange server or canonical

name (alias) information. Although most often seen over UDP, DNS can run over TCP for

requests/responses and always runs over TCP for DNS zone transfers (transfer of information between

DNS servers). The capture filter syntax for DNS traffic is port 53; the display filter syntax is

simply dns.

Domain Name System, see *DNS*

DSCP (Differentiated Services Code Point)—This feature adds prioritization to the traffic using the

DSCP fields in the IP header. To determine if DSCP is in use, apply a display filter for

ip.dsfield.dscp != 0.

dumpcap—This command-line tool is referred to as a "pure packet capture application" and is

included with Wireshark. Dumpcap is used for packet capture by Wireshark and Tshark. Type

dumpcap –h at the command line to learn what options are available when running dumpcap alone.

Editcap—This command-line tool is included with Wireshark and is used to split trace files into file

sets, remove duplicates, and alter trace file timestamps. To see the options available with Editcap,

type editcap –h at the command prompt.

Ethereal—This is the former name of the Wireshark project. On June 7, 2006, Gerald Combs and the

entire development team moved from Ethereal to the new Wireshark home. This name change was

prompted by a trademark issue when Gerald Combs, the creator of Ethereal, moved to his new job at

CACE Technologies.

Ethernet—Developed at Xerox PARC in 1973-1974, Ethernet defines a networking technology that

consists of a physical connection to a shared medium (wire), the bit transmission mechanism, and the

frame structure.

Ethernet header—This header is placed in front of the network layer header (such as IP) to get a

packet from one machine to another on a local network. Once the Ethernet header is placed on the

packet, we refer to it as a frame. The common Ethernet header format is Ethernet II and contains a

destination hardware address (6 bytes), source hardware address (6 bytes) and Type field (2 bytes).

Wireshark looks at the Type field to determine which dissector should receive the packet next. There

is also an Ethernet trailer that consists of a 4–byte Frame Check Sequence field. See also *Ethernet*

trailer.

Ethernet trailer—This 4-byte trailer is added to the end of a packet and consists of a Frame Check

Sequence field (checksum field). Upon receipt of a frame, each device strips off the Ethernet header

and trailer and performs a checksum calculation on the packet content. The receiving device compares

its checksum result against the value seen in the checksum field to determine if the packet is corrupt.

Most NICs strip off the Ethernet trailer before handing the frame to the computer/operating

system/Wireshark.

exclusion filter—This type of filter either drops frames during the capture process (exclusion capture

filter) or removes the frame from view (exclusion display filter). An example of an exclusion capture

filter is not port 80. An example of an exclusion display filter is !ip.addr==10.2.2.2.

Expert Infos—This Wireshark window displays and links to various errors, warnings, notes, and

additional information detected in the trace file. This window also displays packet comments. You can

launch the Expert Infos window by clicking on the **Expert Infos** button on the Status Bar.

File Transfer Protocol, see *FTP*

FIN (Finish)—This bit is set by a TCP host to indicate that it is finished sending data on the

connection. Once both sides of a TCP connection send a packet with the FIN bit set, each side will

begin timing out the connection.

frame—The term used to define a unit of communications that consists of a packet surrounded by a

MAC-layer header and trailer. Wireshark numbers each frame as it is captured or opened (in the case

of a saved trace file). From that point on, however, Wireshark often refers to these frames as "packets"

(**File | Export Specified Packets** for example).

FTP (File Transfer Protocol)—FTP is an established application to transfer data between devices.

FTP runs over TCP using port 21 as a default for the command channel while allowing a dynamic port

number to be assigned to the data channel. The capture filter for FTP command channel traffic on the

default port is port 21. The display filter syntax is tcp.port==21. Although Wireshark recognizes

the filter ftp, this filter will not display the TCP connection establishment, maintenance or tear down

process.

GIMP (GNU Image Manipulation Program) Graphical Toolkit (GTK)—This is the toolkit used to

present the graphical interface—the windows, dialogs, buttons, columns, etc.

heuristic dissector—A heuristic process can be considered "trial and error." Wireshark hands packets over to the dissectors that match the port in use (the "normal dissector"). If Wireshark does not have a normal dissector, it hands the packet off to a heuristic dissector. The heuristic dissector will look at

the information received and, by trial and error, try to see if it fits within the dissector's definition of a

certain protocol or application. If not, it sends an error to Wireshark which sends the packet to the

next heuristic dissector.

hex—Short for hexadecimal, hex refers to the base 16 counting system, in which the digits are 0-9 and

A-F. The Packet Bytes pane displays frame contents in hex format on the left and ASCII format on the

right.

***hosts* file**—Wireshark refers to its own *hosts* file to resolve names when network name resolution is enabled. This file is located in the Wireshark program file directory. As of Wireshark 1.9.0 (which is

the development version leading to Wireshark 1.10), you can place a *hosts* file in your profile

directory and configure Wireshark's name resolution process to look at that file when resolving

names.

HTTP (Hypertext Transfer Protocol)—This is the file transfer protocol used when you browse a

web site. Typically seen over TCP port 80, you can create a capture filter using tcp port 80 or a

display filter using tcp.port==80. Although you could use an http display filter, that filter will

not display the TCP connection establishment, maintenance or tear down process packets.

HTTPS (Hypertext Transfer Protocol Secure)—HTTPS is defined as the secure version of HTTP. In

essence, HTTPS is simply HTTP running over SSL/TLS (Secure Socket Layer/Transport Layer

Security), which are cryptographic protocols. The capture filter for HTTPS traffic is port 443 whereas

the display filter is ssl.

Hypertext Transfer Protocol, see *HTTP*

Hypertext Transfer Protocol Secure, see *HTTPS*

IANA (Internet Assigned Numbers Authority)**—**Based in Marina del Rey, California, IANA is

" *responsible for the global coordination of the DNS Root, IP addressing, and other Internet protocol*

resources. " For network analysts, *www.iana.org* is an invaluable resource for field values, assigned multicast addresses, assigned port numbers, and more.

ICMP (Internet Control Message Protocol)—This protocol is used as a messaging service on a

network. Most people are familiar with the ICMP-based ping operation. ICMP communications

should always be considered when you are troubleshooting network performance. The capture filter

and display filter syntax for ICMP is just icmp.

Internet Assigned Numbers Authority, see *IANA*

Internet Control Message Protocol, see *ICMP*

Internet Protocol (IPv4/v6)—IP is the routed protocol (not the rout *ing* protocol) used to get packets through an internetwork. The capture filter syntax for IPv4 and IPv6 are ip and ip6, respectively. The

display filter syntax for IPv4 and IPv6 are ip and ipv6, respectively.

Internet Storm Center (ISC)—Created by SANS, the ISC offers daily information on security risks

and vulnerabilities. For more information, visit *isc.sans.edu*.

IP address—This address identifies a single host, group of hosts, or all hosts on a network. To create

a capture filter based on an IPv4 address, the syntax is host x.x.x.x. The syntax of an IPv4 display

filter is ip.addr==x.x.x.x. To create a capture filter based on an IPv6 address, use host

xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx. For an IPv6 display filter, use

ipv6.addr==xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx.

ISATAP (Intra-Site Automatic Tunnel Addressing Protocol) traffic— ISATAP is a method to

encapsulate IPv6 packets inside IPv4 headers to be forwarded through an IPv4 network.

key hosts—We use the term "key hosts" to refer to the devices that are critical on the network. They may include the server that maintains the customer database or the CEO's laptop. You define which

host should be tracked and analyzed as a key host.

libpcap—This is the link-layer driver used for packet capture tools, such as Wireshark. There are

numerous other tools that use libpcap for packet capture. For more information, see

sourceforge.net/projects/libpcap/.

link-layer driver—This is the driver that hands frames up to Wireshark. WinPcap, libpcap, and

AirPcap are three link layer drivers used with Wireshark.

logical operators—These operators are used to expand filters to determine if a value is matched in

some form or another. Examples of logical operators are &&, and, ||, or, !, and not. An example of

logical operator use is tcp.analysis.flags && ip.addr==10.2.2.2.

MAC (Media Access Control) address—This address is associated with a network interface card or

chipset. On an Ethernet network, MAC addresses are 6 bytes long. Switches use MAC addresses to

differentiate and identify devices connected to switch ports. They use these addresses to make

forwarding decisions. To build a capture filter based on a MAC address, use the syntax ether host

00:08:15:00:08:15, for example. To build a display filter based on a MAC address, use

eth.addr==00:08:15:00:08:15, for example.

***manuf* file—**This Wireshark file contains a list of manufacturer OUI (Organizational Unit Identifiers) as defined by the IEEE (Institute of Electrical and Electronics Engineers). These three-byte values are

used to distinguish the maker of a network interface card or chipset. In Wireshark, MAC name

resolution is on by default so you will see these OUI values in the MAC addresses (such as Hewlett-

_a7:bf:a3). This *manuf* file resides in the Wireshark program file directory.

Maximum Segment Size, see *MSS*

Media Access Control address, see *MAC address*

Mergecap—This command-line tool is used to merge or to concatenate trace files. If you have a set of

trace files, but you want to create a single IO Graph of all the communications in those trace files,

consider using Mergecap to combine the files into a single file before opening an IO Graph. To

identify the options available with Mergecap, type mergecap –h.

metadata—This is basically "extra data." In Wireshark, we see metadata in the Frame section at the top of the Packet Details pane. Using the .pcapng format, you can also add your own metadata through

trace file annotations and packet annotations.

MSS (Maximum Segment Size)—This value defines how many bytes can follow a TCP header in a

packet. During the TCP handshake, each side of the conversation provides their MSS value. A

common MSS value on an Ethernet network is 1,460.

multicast—This is a type of address that targets a group of hosts. At the MAC layer, most multicast

addresses begin with 01:00:5e while IPv4 multicasts begin with a number 224 through 239 in the first

IP address byte location. An example of an IPv4 multicast is 224.0.0.2, which is targeted at all local

routers. IPv6 multicasts have the preface ff00::/8 (the "8" signifying that the first 8 bits are the bits we are interested in).

name resolution—This feature is used to associate a name with a device, network interface card/chip,

or port. Wireshark supports three types of name resolution: MAC name resolution, transport name

resolution, and network name resolution. MAC name resolution is on by default and resolves the first

three bytes of hardware addresses to a manufacturer name (such as Apple_70:66:f5). Transport name

resolution is on by default and resolves port numbers to port names (such as port 80 resolved to *http*).

Network name resolution is off by default and resolves an IP address to a host name (such as

74.125.19.106 resolving to *www.google.com*). In Wireshark, when you enable network name

resolution, Wireshark may generate a series of DNS Pointer queries to obtain host names. As of

version 1.9.0 (which is the development version leading to Wireshark 1.10), Wireshark can be

configured to look at a hosts file for network name resolution, rather than generating DNS Pointer

queries. You can even have a separate *hosts* file for each profile.

NAT (Network Address Translation)—NAT devices alter the IP address of hosts while maintaining

a master list of all the original IP addresses and the new addresses in order to forward traffic back to

the correct address. NAT is often used to hide internal addresses from the outside world or enable an

organization to use simple private IP addresses, such as 10.2.0.1.

NetBIOS (Network Basic Input/Output System)—This is the session-level protocol used by

applications, such as SMB, to communicate among hosts on a network, typically a Microsoft-product

network. In Wireshark, you can apply a display filter for nbss (NetBIOS Session Service) or nbns

(NetBIOS Name Service).

Network Address Translation, see *NAT*

Network Basic Input/Output System, see *NetBIOS*

network interface card (NIC)—This card, which is typically just a chipset, offers the physical

connection to the network. NICs now offer greater capability than just applying a MAC header to the

packets. Some hosts now support task offloading, which relies on the NIC for various functions such

as segmenting TCP data and applying IP, UDP, and TCP checksum values. See also *Task offload*.

Nmap—This network mapping tool was created by Gordon Lyons (Fyodor) to discover and

characterize network hosts. For more information, visit *nmap.org*.

Packet Bytes pane—This is the bottom pane displayed by default in Wireshark. The Packet Bytes

pane shows the contents of the frame in both hexadecimal and ASCII formats. When you click on a

field in the Packet Details pane, Wireshark highlights those bytes and the related ASCII characters in

the Packet Bytes pane. To toggle this pane between hidden and displayed, select **View | Packet Bytes**.

packet comments (aka packet annotations)—As of Wireshark 1.8, you can right-click on a packet in

the Packet List pane and choose **Add or Edit Packet Comments**. This feature is only supported in

trace files saved in the .pcapng format. Packet comments are shown above the Frame section in the

Packet Details pane. To view packet comments, open the Expert Info window and click on the **Packet**

Comments tab. As of Wireshark 1.9.0 (which is the development version leading to Wireshark 1.10),

you can export all trace file and packet comments using **Statistics | Comments Summary | Copy**.

Packet Details Pane—This is the middle pane displayed by default in Wireshark. This pane shows the

individual fields and field interpretations offered by Wireshark. When you select a frame in the Packet

List pane, Wireshark displays that frame's information in the Packet Details pane. To toggle this pane

between hidden and displayed, select **View | Packet Details**. This is likely a pane you will use very

often in Wireshark because you can right-click on a field and quickly apply a display filter or coloring

rule based on that field.

Packet List pane—This is the top pane displayed by default in Wireshark. This pane shows a

summary of the individual frame values. When you select a frame in the Packet List pane, Wireshark

displays that frame's information in the Packet Details pane. To toggle this pane between hidden and

displayed, select **View | Packet List**. This is likely a pane you will use very often in Wireshark as you

can right-click on a frame and quickly apply a conversation filter or reassemble communications

using **Follow TCP stream**, **Follow UDP stream**, or **Follow SSL stream**.

packet—This is the term used to describe the elements inside a MAC frame. Once you strip off the

frame, you are looking at a packet. We use this term loosely in analysis. Although Wireshark displays

frames, we often refer to them as "packets".

.pcap **(Packet Capture)—**This trace file format is the default format for earlier versions of Wireshark (before Wireshark 1.8). This format is also referred to as the tcpdump or libpcap trace file format.

.pcapng, **also .** ***pcap-ng*** **(.pcap Next Generation)—**This trace file format is the successor to the .pcap format. This new format facilitates saving metadata, such as packet and trace file comments, local

interface details, and local IP address, with a trace file. For more information about the .pcapng

format, see *wiki.wireshark.org/Development/PcapNg*.

PCRE (Perl-Compatible Regular Expressions)—Regular expressions is a search-pattern language

used to match strings of characters, numbers, or symbols. "Perl-Compatible" defines the flavor of

regular expressions that Wireshark supports. See also *Regular expressions (regex)*.

Perl-Compatible Regular Expressions, see *PCRE*

Per-Packet Interface, see *PPI*

Pilot, see *Cascade Pilot*®

port spanning—This process is used to configure a switch to copy the traffic to and from one or more

switch ports down the port to which Wireshark is connected. Not all switches support this capability.

Some people refer to this as port mirroring. Note that port spanned switches will not forward corrupt

packets to Wireshark. See also *Tap*.

PPI (Per-Packet Interface)—PPI is an 802.11 header specification that provides out-of-band

information in a pseudoheader that is prepended to the 802.11 header. Used by AirPcap adapters, the

PPI pseudoheader includes channel-frequency information, signal power, noise level, and more.

***preferences* file—**This file contains the protocol preference settings, name resolution settings, column settings, and more. Each profile has its own *preferences* file, which is contained in the personal

configurations folder.

Prepare a Filter—This task can be performed by right-clicking on a packet in the Packet List pane.

Prepare a Filter creates, but does not apply, a display filter based on the selected element. See also

Apply as Filter.

profiles—Profiles contain the customized configurations for Wireshark. There is a single profile

available on a new Wireshark system—the *Default* profile. The current profile in use is displayed in

the right side of the Status Bar. To switch between profiles, click on the **Profile** area in the Status Bar.

To create a new profile, right-click on the **Profile** area.

Protocol Data Unit (PDU)—This is a set of data transferred between hosts. In Wireshark, you will

see [TCP segment of a reassembled PDU] when you allow the TCP subdissector to reassemble TCP

streams. In essence, these packets contain segments of a file that is being transferred.

Protocol Hierarchy window—This window breaks down the traffic according to the protocols in use

and provides details regarding packet percentages and byte percentages. This window is available

under the Statistics menu option. Watch for unusual protocols or applications or the dreaded "data"

under TCP, UDP, or IP. This designation means that Wireshark does not recognize the traffic, which is

unusual considering the number of dissectors included in Wireshark.

protocol preferences—These preferences define how Wireshark handles various protocols and

applications. Protocol preferences are set by right-clicking on a protocol in the Packet Details pane, by

selecting **Edit | Preferences** from the menu or by clicking the **Edit Preferences** button on the main

toolbar.

QoS (Quality of Service)—This term refers to a method of prioritizing traffic as it travels through a

network. QoS settings can be defined on interconnecting devices (forward web browsing traffic before

email traffic, for example) or by an application. When defined by an application, the DSCP bits can be

set to prioritize the traffic over other traffic. See also *DSCP*.

Quality of Service, see *QoS*

Regular Expressions (Regex)—Regex is a search-pattern language used to match strings of

characters, numbers, or symbols. Wireshark uses Perl-Compatible Regular Expressions (PCRE) when

you use the matches operator in display filters. For more information on regular expressions, see

www.regular-expressions.info. See also *PCRE*.

relative start (Rel.Start)—This value is shown in the Conversations window and indicates the first

time this conversation was seen in the trace file. You may need to expand the Conversations window

to see this column. The time is based on seconds since the first packet in the trace file.

remote capture—This term describes the process of capturing traffic at one location and analyzing it

at another location. WinPcap includes a remote capture tool (*rpcapd.exe*) that Wireshark can access

through the Capture Options window (Manage Interfaces).

RST (Reset)—This bit is set by a host to terminate a TCP connection. Once this bit has been set in an

outbound packet, the sender cannot send any further data on that connection. In a typical TCP

connection termination process, each side of the connection sends a packet with the RST bit set and

the connection is immediately closed.

Server Message Block, see *SMB*

***services* file**—This file contains a list of port numbers and service names. All TCP/IP hosts have a *services* file and Wireshark has its own *services* file as well. This file resides in the Wireshark program

file directory. When transport name resolution is enabled, Wireshark replaces port numbers

with service names. For example, port 80 would be replaced with "*http*." You can edit this file if you do not like the service names displayed.

Simple Network Management Protocol, see *SNMP*

SMB (Server Message Block)—Also referred to as Common Internet File System (CIFS), SMB is an

application layer protocol used to provide network access, file transfer, printing, and other functions

on a Microsoft-based network.

SNMP (Simple Network Management Protocol)—This device management protocol requires that a

managed device maintain a database of managed items. Managing hosts view and/or edit that

database. You may see SNMP traffic flowing between network hosts and network printers, which

often have SNMP enabled to track information such as ink levels, paper levels, and more. To filter on

SNMP traffic use the capture filter port 161 or port 162 or the display filter snmp.

Snort—Snort is a Network Intrusion Detection System (NIDS) that was created in 1998 by Martin

Roesch and is currently maintained by Sourcefire. Snort relies on a set of rules to identify and

generate alerts on network scans and attack traffic. For more information, see *snort.org.*

Stream index number—This number is applied to each TCP conversation seen in the trace file. The

first Stream index number is set at 0. When you right-click on a TCP communication in the Packet

List pane and choose **Follow TCP stream**, Wireshark applies a display filter based on this Stream

index number (for example, tcp.stream==3.

stream reassembly—This is the process of reassembling everything after the transport-layer header

(TCP or UDP) enabling you to clearly read through the requests and replies in a conversation.

Communications from the first host seen are colored red; communications from the second host seen

are colored blue.

subdissector—This is a dissector that is called by another dissector. You will see this term when you

view TCP preferences (*Allow subdissector to reassemble TCP streams*). In the case of web browsing

traffic, the HTTP dissector is a subdissector of the TCP dissector.

subnet—This term defines a subset of a network and is applied by lengthening network masks. For

example, if you want to create two subnets out of a single network, network 10.2.0.0/16 for example,

lengthen the subnet to /24 (24-bits) and assign 10.2.1.0/24 to some hosts and 10.2.2.0/24 to other

hosts. The network mask indicates that we have two networks now.

SYN (Synchronize Sequence Numbers)—This bit is set in the first two packets of the TCP

handshake to synchronize the initial sequence numbers (ISNs) from each TCP peer. You can use a

display filter based on this bit to view the first two packets of each handshake

(tcp.flags.syn==1) which can be used to determine the round trip time between hosts.

TAP, aka tap (Test Access Port)—These devices are used to intercept network communications and

copy the traffic down a monitor port. Basic taps do not make any forwarding decisions on traffic and

offer a transparent view of network communications. NetOptics is a company that makes network taps

(see *www.netoptics.com*). See also *port spanning*.

task offload—This process offloads numerous processes to the network interface card to free up the

host's CPU for other tasks. Task offload can affect your analysis session when checksums are

calculated by the network interface card on a host upon which you are running Wireshark. Since

checksum values haven't been calculated yet, they are incorrect at the point of capture. If you enable

IP, UDP, or TCP checksum validation, or you have the Checksum Errors coloring rule enabled, you

may see numerous false positives caused by task offload of the checksum calculation.

TCP/IP (Transmission Control Protocol/Internet Protocol)—This term refers to an entire suite of

protocols and applications that provide connectivity among worldwide computer systems. The term

"TCP/IP" refers to more than TCP and IP, it refers to UDP, ICMP, ARP, and more.

Teredo IPv6 traffic—Teredo is a tunneling method that encapsulates an IPv6 header inside a UDP

packet. This technology was developed to assist with crossing Network Address Translation (NAT).

Teredo is covered in RFC 4380, *Teredo: Tunneling IPv6 over UDP through Network Address*

Translations (NATs).

TFTP (Trivial File Transfer Protocol)—This file transfer protocol runs over UDP offering minimal

file transfer functionality. Most commonly, TFTP uses port 69, but you must keep in mind that many

applications can be configured to run over non-standard port numbers. Unexpected TFTP traffic can

be a symptom of a security breach on your network.

Trivial File Transfer Protocol, see *TFTP*

Time to Live, see *TTL*

trace file—This general term refers to all files that contain network traffic, regardless of the format of the file. Wireshark currently uses the .pcapng trace file format, but it can understand most other

common trace file formats. Trace files generally include a file header (which contains information

about the entire trace file, including the indication of the trace file format in use) and packet headers

that include metadata (such as comments) about individual packets.

Transport Layer Security, see *TLS*

TLS (Transport Layer Security)—TLS is a cryptographic protocol based on Secure Socket Layer

(SSL). When analyzing TLS traffic, you can look at the initial TLS handshake packets to identify

connection establishment problems. To decrypt this traffic, you must have the appropriate decryption

key. TLS preferences are configured under the SSL preference area in Wireshark. To capture

TLS/SSL-based traffic, use a port-based capture filter, such as port 443. The display filter syntax for

TLS/SSL-based traffic is SSL.

Tshark—This command-line tool can be used to capture, display, and obtain basic statistics on live

traffic or saved trace files. Tshark relies on dumpcap to actually capture the traffic. By far the most

feature-rich version of the command-line capture tools, you can type tshark -h to find the list of

available Tshark parameters.

Time to Live (TTL)—This IP header field is decremented by each router as it is forwarded along a

network path. If a packet arrives at a router with a TTL value of 1, it cannot be forwarded because you

cannot decrement the TTL to zero and forward the packet. The packet will be discarded.

UDP (User Datagram Protocol)—This connectionless transport protocol is used by many basic

network communications, including all broadcasts, all multicasts, DHCP, DNS requests, and more.

The capture filter and display filter syntax to capture UDP is udp.

URI (Uniform Resource Indicator)—This term defines the actual element being requested in an

HTTP communication. For example, when you analyze a web browsing session, you might see a

request for the "/" URI. This "/" is a request for the default page (*index.html*, for example). To build a display filter to show any packets that contain a URI, use http.request.uri.

User Datagram Protocol, see *UDP*

WinPcap (Windows Packet Capture)—This Windows-specific link-layer driver is used by

Wireshark to capture traffic on a wired network. Originally created by Loris Degioanni. WinPcap is

the industry leading utility for various network tools. For more information, see *www.winpcap.org.*

Wiretap Library—This library gives you the raw packet data from trace files. Wireshark's Wiretap

Library understands many different trace file formats and can be seen when you select **File | Open** and

click the drop-down arrow next to **Files of Type**.

WLAN (Wireless Local Area Network)—This term describes networks that rely on RF (radio

frequency) media to communicate between hosts. Wireshark contains dissectors for various WLAN

traffic elements. The AirPcap adapter is a great adapter for capturing WLAN traffic.

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Top 10 Reasons Your Network is Slow

TCP Analysis In-Depth

DHCP/ARP Analysis

Nmap Network Scanning 101

WLAN Analysis 101

Wireshark 201 Filtering

New Wireshark Features

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Analyzing Google Secure Search

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information. Contact us at *info@chappellU.com* if you have questions regarding your All Access Pass membership.

[1] SecTools.Org: Top 125 Network Security Tools, *sectools.org*.

[2] eWEEK/eWEEK Labs, May 28, 2012, see *www.eweek.com/c/a/Linux-and-Open-Source/The-Most-Important-OpenSource-Apps-of-All-Time/11/*

[3] See *portableapps.com* for more information about this platform.

[4] See *www.wireshark.org/download/automated/sloccount.txt* for the current SLOCCount estimates.

[5] Many Wireshark web page names include upper case and lower case characters. Use the proper case or you will receive the dreaded "im in ur servr sniffin ur paketz" cat (404 error message).

[6] A true switch does not offer any routing functionality. The only purpose of a true switch is to learn what machines are connected to it (based on MAC addresses) and forward traffic accordingly.

[7] One other item can be sent down your switch port—traffic to an unknown MAC address. If all goes well, this should rarely happen. We have resolution processes to ensure we know target MAC addresses and we should only see MAC addresses that are in use on the network.

[8] Note that the URL is case sensitive. If you browse to wiki.wireshark.org/ethernet (all lower case), you will see a message indicating that "This page does not yet exist."

[9] We hid columns at various points in this book to enable us to show more information contained in other columns.

[10] This will be an important task when you create display filters later in this book.

[11] This trace file—and all the other trace files mentioned in this book—are available at

www.wiresharkbook.com.

[12] Your own web browsing traffic to www.google.com may be quite different. If you had recently accessed the site, your browser will have parts of the Google web site in cache. You won't see those

elements being sent from the Google server.

[13] If you see [TCP segment of a reassembled, PDU] instead of OK in frame 10, don't worry. By default, Wireshark shows the reassembly message when the OK response includes part of the data

being sent to the client. You will work with this setting in Chapter 1.

[14] See *isc.sans.edu/ipinfo.html?ip=183.63.31.122*.

[15] As of Wireshark 1.9.0 (which is the development version leading to Wireshark 1.10), network name resolution can be performed by referring to a Wireshark *hosts* file and looking at the DNS

packets in a trace file. If you want Wireshark to generate DNS PTR queries to resolve names, use the

Use external network name resolver setting (enabled by default). You can also enable *Use hosts file*

from profile dir only to maintain separate *hosts* files for each of your customized Wireshark profiles.

[16] The remaining labs in this book assume you have successfully completed this lab.

[17] You can create new profiles based on existing profiles using **Edit | Configuration Profiles |**

Copy or right-click on the **Profile** area on the **Status Bar**, select **New** and select an existing profile from the **Create From** drop-down list. You will create a new profile based on the *Default* profile in Lab 7.

[18] Don't laugh at this one—I've seen this happen before. A slight misconfiguration among the IT

team and an energetic intern dragged this network to the ground. It began with big path delays and

then deteriorated to monstrous packet loss. I think the intern makes balloon animals at the mall for a

living now.

[19] Ok, walking probably isn't an option—unless you are trying to distract yourself from the ridiculously long wait time you will have trying to download a file from this HTTP server. You folks

in Australia—I love ya, but your Internet links are horrid. You're accustomed to these kinds of latency

times.

[20] If packets 432 and 20 appear as [TCP segment of a reassembled PDU], you need to change your TCP preference settings to disable *Allow subdissector to reassemble TCP streams*. Select **Edit |**

Preferences | (+) Protocols | TCP to set this.

[21] The term "tap" is used as a general term for the acronym TAP.

[22] The signal strength information is not contained in a field of the 802.11 header, so this information must be added by the adapter or a special driver.

[23] Since Dumpcap is the tool that is capturing traffic for Wireshark, it is actually Dumpcap that can be overwhelmed if traffic is arriving faster to Dumpcap than Wireshark is picking it up from

Dumpcap.

[24] I was fortunate to sit with Loris during the initial design phase of Cascade Pilot before it even had an interface. The underlying architecture was sleek and sophisticated. Watching the product take

shape and discussing potential features was a fabulous experience.

[25] I generally tell folks to avoid capture filters whenever possible. This is because you can't get those packets back after you filter them out. An ideal time to use capture filters is when Dumpcap

can't keep up with the traffic. So let's lighten up the load heading to the Capture Engine.

[26] If you have a dual-stack host, it is much more effective to make a single filter based on your MAC address than to make a more complex filter based on your IPv4 and IPv6 addresses.

[27] On a Windows host select **Start** and select the **Command Prompt** from the program list or type cmd in the file search area. On a MAC OS X host, open **Applications | Utilities | Terminal**.

There are various terminal applications available on Linux hosts—look for *terminal* or *Xterm*, for example.

[28] Watch out for VoIP display filters—for some reason there are several VoIP-related display filters that use upper case and lower case characters.

[29] Watch out when using display filters based on a TCP-based application name. Running a filter for "http" will not show you the entire picture of a browsing session. For more information, see *Be Cautious Using a TCP-based Application Name Filter*.

[30] You will learn to use the right-click **Prepare a Filter** and **Apply as Filter** features to create a filter based on a field name and value in *Quickly Filter on a Field in a Packet*.

[31] Be careful using the != operator. Refer to *Why didn't my ip.addr != filter work?* for more details on issues with this operator.

[32] Yes—that is the same "Hearst" as Patty Hearst, the famous Symbionese Liberation Army (SLA) bank robber/millionaire socialite. The Hearst Corporation was founded by Patty Hearst's grandfather,

William Randolph Hearst.

[33] We could have also used **http.request.method contains "POST"** .

[34] You must enable Wireshark's network name resolution process (**Edit | Preferences | Name Resolution**) in order to use this display filter.

[35] You do not need to clear the previous filter because the new filter will replace the existing one.

[36] This is not a typo. The HTTP specifications spell Referer this way (with a missing "r").

[37] The new display filter title "Wireshark 101 Book Sample Display Filters" uses the filter string frame. It will not filter anything out of view if someone clicks on it by mistake.

[38] X11 is a software and network protocol that provides a graphical interface.

[39] We are using the "S-" to indicate this is a security concern. This is just for your information when you see what coloring rules are associated with frames.

[40] Use a logarithmic scale when you are plotting disparate number values. You will practice your logarithmic graphing skills in Lab 36.

[41] The MaxMind web site underwent a complete redesign during development of this book. The direct link to the GeoLite database files is *www.maxmind.com/en/opensource*, but this may change.

Just look around their web site for any reference to the GeoIP database and the GeoLite files.

[42] The only way to really know what is "unusual" is to know what is usual. Capture and analyze your traffic to learn what applications are typically seen on your network.

[43] For those of you reading the paperback book version, you will need to open the trace file in Wireshark to see the colors. Printing color books is still cost-prohibitive, so the paperback is in black

and white. However, the eBook versions are in color.

[44] Be sure to enable the *Allow subdissector to reassemble TCP streams* TCP preference setting before attempting reassembly.

[45] Wireshark automatically detects if you right-clicked on a TCP, UDP or SSL stream. SSL

streams must be decrypted to be reassembled and viewed.

[46] If you captured the browsing session beginning with the TCP handshake, the client communications will be in red and the server communications will be in blue.

[47] You must configure Wireshark with a decryption key in the SSL preferences area in order to follow SSL streams and view the decrypted traffic.

[48] If you did not save your **Host** column, return to Lab 15 and follow the steps to create the column again.

[49] As of the writing of this book, Network Miner could not import .pcapng files. To convert a

.pcapng file to a .pcap file format, open the file and select **File | Save As** and choose the

Wireshark/tcpdump/... - libpcap format. Use the .pcap extension when you name your file.

[50] The **Trace File Annotation** button will not appear if you are looking at a file saved in *.pcap* format. Select **File | Save As** to save the file in *pcapng* format if you wish to use trace file or packet annotations.

[51] Note that the Expert Infos window shown displays the Expert LEDs. This is a User Interface preference setting that can help you become accustomed to the Expert Infos color coding system.

[52] For step-by-step instructions for adding the Wireshark program directory to your path, perform a Google search for "add directory to path for < *operating system*>."

[53] Be certain to add the Wireshark program directory to your path as mentioned.

[54] You only need to use quotes around a file name if it contains spaces. Adding quotes around all file names may be a good habit to get into, however.

[55] We keep mentioning this—have you done it yet?

[56] Note that the Capture output option area implies that you must use a ring buffer. You don't. We will just use the *duration:NUM(secs)* capability of this parameter.

[57] You do not need a space between the **–i** parameter and the interface number.

[58] Time to get a lock on your door, eh?

Document Outline

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